CGIAR Research Program 1
Dryland Cereals and Legumes Agri-Food Systems

Delivering Development and Dignity through Diversification in Drylands
# CONTENTS

## PART-I
1. EXECUTIVE SUMMARY .................................................................................................................. 3
2. PART I – PROGRAM LEVEL SUMMARY .......................................................................................... 4

## PART-II
3. FLAGSHIP 1: PRIORITY SETTING & IMPACT ACCELERATION ......................................................... 15
4. FLAGSHIP 2: PRE-BREEDING & TRAIT DISCOVERY ..................................................................... 28
5. FLAGSHIP 3: VARIETY & HYBRID DEVELOPMENT ..................................................................... 39
6. FLAGSHIP 4: SEED SYSTEMS AND INPUT SERVICES .................................................................. 47
7. FLAGSHIP 5: INTEGRATED LAND, WATER and CROP MANAGEMENT ........................................... 56
8. FLAGSHIP 6: Improved Rural Livelihood Systems ....................................................................... 65
9. FLAGSHIP 7: POST-HARVEST VALUE ADDITION & OUTPUT MARKETS .......................................... 78
10. Gender Research in DCLAS AFS CRP ......................................................................................... 90

## ANNEXURES
11. Annex 1. Water use efficiency, energy, fat, carbohydrate and protein per mm water used for 8 crops in India ....................................................................................................................................... 95
13. Annex 3. COUNTRY SELECTION CRITERIA & DATA FOR DCLAS ...................................................... 97
15. Annex 5. DCLAS COUNTRY ENGAGEMENT FRAMEWORK ............................................................... 100
17. Annex 7. PROPOSED CRP-CRP LINKAGES FOR DCLAS ................................................................ 128
18. Annex 8. GOVERNANCE & MANAGEMENT OF DCLAS .................................................................. 138
19. Annex 9. THE DRAFT ORGANIZATIONAL CHART FOR DCLAS ....................................................... 145
20. Annex 10. MONITORING, EVALUATION & LEARNING SYSTEM FOR DCLAS ................................. 146
21. Annex 11. RISK MANAGEMENT IN DCLAS .................................................................................... 147
22. Annex 12. DCLAS BUDGET ESTIMATION ....................................................................................... 148
23. Annex 13. COUNTRY-BASED DETAILED PERFORMANCE INDICATOR MATRICES .............................. 150
25. Annex 15. CVs OF THE DCLAS FLAGSHIP WRITING TEAM ......................................................... 193
27. Annex 17. ISPC & FC 'Must-Haves' ............................................................................................... 263
28. Annex 18. PERFORMANCE INDICATOR METRICS ....................................................................... 266
PART - I
EXECUTIVE SUMMARY

The CGIAR Research Program (CRP) 1 on Dryland Cereals and Legumes Agri-Food Systems is a global partnership that aims to improve livelihoods in the dryland regions of Africa, Asia and Latin America through demand-driven innovations that improve agricultural productivity, natural resource management and economic growth of farming systems centered on dryland cereals, grain legumes and livestock. Rising to the challenging call for a more consolidated CGIAR portfolio, and seizing the unique opportunity for a comprehensive and holistic approach to address smallholder livelihoods, especially that of women, in drylands, three CGIAR Phase I research programs have combined their expertise, efforts and resources into streamlined implementation for efficient and effective delivery of impact at scale. Beyond a simple integration, the individual components of the new program, namely, Dryland Systems, Dryland Cereals and Grain Legumes, allow the anchoring of research-for-development (R4D) efforts on the principal component crops of subsistence farmers in dryland agricultural systems in an attempt to create sustainable economic growth, food and nutrition security, and natural resource management through a system-based approach. Newer partnerships for R4D on livestock and agroforestry ensure a comprehensive effort to address livelihood improvement in drylands. In addition, the significant contributions of grain legumes to nutrition, soil health and climate-change mitigation are realized through a coordinated effort on key legume crops of both dryland and humid-tropic geographies under a single umbrella. Alignment with other Agri-Food System programs and the Global Integrating Programs of the new CGIAR portfolio provides the ability to leverage expertise, models, platforms and sites beyond the purview of DCLAS to execute with quality and rigor. ISPC- and CO-guided preparatory structuring of the commodity CRPs of the current extension phase has educated the organization of the flagships of the new program along a delivery pipeline: (1) Priority Setting and Impact Acceleration, (2) Pre-Breeding and Trait Discovery, (3) Variety and Hybrid Development, (4) Seed Systems and Input Services, (5) Integrated Land, Water and Crop Management, (6) Improved Rural Livelihood Systems, and (7) Post-harvest Value Addition and Output Markets. A gender strategy housed within Flagship 1, but mainstreamed into all others, ensures planning and implementation of gender-integrated research across the pipeline, while also facilitating strategic gender research related to improved livelihoods based on accumulated gender-disaggregated data. Despite the apparent linearity of such a structure, intentional emphasis on coordinated operation of such a delivery pipeline ensures a feedback loop from Flagship 6 back to Flagship 1 for informed and agile decision-making on program design and resource allocation to enable continuous contribution to the CGIAR System-Level Outcomes within changing regional and global contexts. A youth strategy linked to Digital Agriculture persuades rural youth of a technology-driven agricultural future, thus enabling improved operational efficiency in agriculture and the consequent economic growth from agriculture. Traditional capacity development courses and distance learning combined with the already established Dryland Cereals and Grain Legumes global scholarship programs ensures sustainable agricultural research in the focus regions of the program. Existing and developing private-sector partnerships on various fronts open various avenues to upscale and to on-board novel cutting-edge technologies. Lessons learned in governance and management during the first and extension phases of the component CRPs of the current program ensures adherence to the guidelines of the Independent Evaluation Arrangement of the ISPC on this important aspect of CRP implementation. Finally, a novel robust Monitoring and Evaluation system has been developed and will be applied to real-time tracking of project implementation, budget utilization and output delivery to facilitate ongoing Results-Based Management.
PART I – PROGRAM LEVEL SUMMARY

PROGRAM OVERVIEW

Strategic Relevance and Problem Addressed

The overriding hypothesis of DCLAS is the contention that poor women, men and young farmers in the risky dryland systems of Africa, Asia and Latin America can produce, consume and, benefit from selling their cereal, legume, livestock, cash-crop and timber and non-timber tree commodities into increasingly functional, diverse and emerging agri-food value chains. We have taken an integrated systems approach that is built on primary value chains of commodities most important for sustainable intensification and economic opportunity for the poorest segment of rural society that predominantly live in the dryland ecologies of sub-Saharan Africa and South Asia. Drylands cover over 40% of the world’s land area and are home to approximately 2.5 billion people, a third of the world’s population, of which 16% live in chronic poverty (Hyman et al. 2008). The twelve dryland cereals and grain legumes which anchor this agri-food system program primarily in the drylands, not excluding relevant other ecologies, cover a total harvested area of 147.680 million hectares with a dry-grain production of 141.740 million tonnes (FAOSTAT 2013). The extent and importance of the drylands are indicated in Tables 1 and 2 below (ISPC 2015).

Table 1: Global importance of drylands

<table>
<thead>
<tr>
<th>Dryland type</th>
<th>Aridity index</th>
<th>Share of global area (%)</th>
<th>Share of global population (%)</th>
<th>% rangeland</th>
<th>% cultivated</th>
<th>% other (incl. urban)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hyper-arid</td>
<td>&lt;0.05</td>
<td>6.6</td>
<td>1.7</td>
<td>97</td>
<td>0.6</td>
<td>3</td>
</tr>
<tr>
<td>Arid</td>
<td>0.05-0.20</td>
<td>10.6</td>
<td>4.1</td>
<td>87</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>Semi-arid</td>
<td>0.20-0.50</td>
<td>15.2</td>
<td>14.4</td>
<td>54</td>
<td>35</td>
<td>10</td>
</tr>
<tr>
<td>Sub-humid</td>
<td>0.50-0.65</td>
<td>8.7</td>
<td>15.3</td>
<td>34</td>
<td>47</td>
<td>20</td>
</tr>
<tr>
<td>Total</td>
<td>41.3</td>
<td>35.5</td>
<td>65</td>
<td>25</td>
<td>25</td>
<td>10</td>
</tr>
</tbody>
</table>

Efforts of the CGIAR have predominantly focused on the semi-arid and sub-humid regions that share the greatest proportion of the population, highest malnutrition rates, and lowest level of human well-being (MEA, 2005).

Table 2: Dimension of key dryland challenges by SLO

<table>
<thead>
<tr>
<th>SLO1</th>
<th>SLO2</th>
<th>SLO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor people (mill.)</td>
<td>Undernourished people (mill.)</td>
<td>Stunted children under 5 (mill.)</td>
</tr>
<tr>
<td>Global</td>
<td>1,033</td>
<td>676</td>
</tr>
<tr>
<td>Total for all CRPs target countries</td>
<td>1,044</td>
<td>666</td>
</tr>
<tr>
<td>Total for dryland areas</td>
<td>523</td>
<td>93% in drylands?</td>
</tr>
<tr>
<td>Total for target countries of DS CRP</td>
<td>542*</td>
<td>295*</td>
</tr>
</tbody>
</table>

(*Estimates based on totals for 19 target countries for the Dryland Systems CRP, not covering all the drylands and including non-dryland areas within countries)

In Africa, 43% of the land is drylands, housing 45% of the population or about 325 million people. Similarly 40% of Asia is dryland, with over 40% of the population. Water scarcity is the main limiting factor to agricultural productivity and threatens dryland populations. The recent World Economic Forum states that water scarcity is a bigger risk than pandemics, interstate conflicts, failure to adapt to climate change and biodiversity loss and ecosystem collapse (WEF, 2015). The concept of water use efficiency (WUE; kg
grain/ha/mm water used) is well accepted for the efficiency of grain production. The Stockholm International Water Institute (SIWI, 2004) extended the concept further by considering the production of food nutrition per mm (or drop) of rainfall. Based on early analysis, we see the need for standardized, real-time data for available soil water across countries, regions and soil types to estimate water use efficiency across crops to prioritize interventions and management options. However, the nutrition story now is that sorghum and maize are highest per mm for energy, soybean for fat and protein, and sorghum has the highest potential for carbohydrate per mm. We are assessing other nutritional components such as micronutrients per drop for the full proposal (Annex 1).

Alignment with SRF and Value Proposition
The program contributes to all three System Level Outcomes of the CGIAR Strategy and Results Framework, namely, (1) reduced poverty, (2) improved food and nutrition security, and (3) improved natural resource systems and ecosystem services. Our initial effort to develop the value proposition for this program is outlined below. We acknowledge that this is far from perfect, but given the data available this does provide a reasonably rational estimate for impact. Given our focus to deliver on the SRF by 2030, it was decided to be more granular and accountable by setting goals at the country level for each of the three SLOs. The Lead Centre, ICRISAT, is in the process of developing country strategies, and the strategy for Ethiopia is one example in the early stages. We have estimated goals for both the time-frame of the second phase of CRPs (2017-2022) as well as that of the SRF (2030). The methodology for developing these estimated goals was based on the area grown within the drylands of the target developing countries, for each commodity within DCLAS, as well as for the major areas for common bean, cowpea and soybean. Based on existing productivity trends for each crop in each country (FAOSTAT 2013), it is estimated that this CRP through partnerships will realize 15% additional growth during the next five years and 20% over the following 8 years through to 2030. We have discounted by crop and country the ability to deliver the results of research based on our understanding of context (e.g. infrastructure, partners for scaling and culture) for each commodity and country. We have also taken into account where we have the greatest activities and strongest partnerships that will further influence the CRP’s ability to scale adoption of farmer-preferred technologies. Based on the above process and drawing on World Bank Development Indicators for Poverty and Nutrition in addition to UNICEF data on under-weight child births, we have estimated the cumulative impact of DCLAS as follows:

<table>
<thead>
<tr>
<th></th>
<th>2022</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>Families exiting Poverty (Million)</td>
<td>8</td>
<td>16</td>
</tr>
<tr>
<td>Families escaping Malnutrition (Million)</td>
<td>21</td>
<td>45</td>
</tr>
<tr>
<td>Land being saved from degradation (Million Hectares)</td>
<td>27</td>
<td>35</td>
</tr>
</tbody>
</table>

It is worth noting that the significant impacts on malnutrition are logical given the nutritional density of the diverse crops (legumes and nutri-cereals like pearl and finger millet, noting especially their contributions of Fe, folate and Zn) and livestock that will be developed and delivered to serve the regions of the world where malnutrition is concentrated, namely dryland ecologies of the developing world.

The target countries for the program are presented in Annexes 2 and 3, with separate identification of countries for site integration efforts, and of countries for DCLAS Flagship activities. Selection of countries for Phase II is based on (1) area, production, and productivity of the anchor commodity crops, (2) poverty, (3) malnutrition, (4) drought probability (for regions anchored on the commodity crops of the program), (5) better enabling environment, and (5) CG-level site integration. The selected countries are divided into (a) direct target countries and (b) regional transect countries that include a group of small countries with shared agroecologies or enabling environment that provide a critical mass when combined for delivering on the SLOs. To maximize the impact per dollar invested, country-wise investment priorities for the Flagships of the program can be prioritized based on Annex 2 and relevant associated data. All countries which are tiered into such categories will further be analyzed with the aid of another framework that will help determine country-specific research goals. Both these frameworks will be along the lines of the Boston Consulting Group (BCG) Portfolio Matrix which enable companies to rationalize their product portfolio. We are in the process of
Adapting and modifying this framework to develop specific country strategies in the case of the DCLAS portfolio.

**Added Value of Being a Program, Theory of Change & Impact Pathway**

Integration of a systems approach rich in the expertise, experience and lessons from Dryland Systems, on a commodity anchor, namely Dryland Cereals and Grain Legumes, positions DCLAS to effectively deliver research outputs that are expected to lead to important outcomes in behavioral and capacity changes across a wide reach of recipients and livelihood systems. The recipients of these outcomes include farming households and communities, consumers, input suppliers and processors, seed industries, policy makers and institutions, research partners, NGOs and development partners. Ultimately, these behavioral and capacity changes contribute to the IDOs and sub-IDOs identified below, under the section on Flagships. The integrated Theory of Change (ToC) for DCLAS is informed by location-specific market requirements (FP1 and FP7) and constraints analysis (FP1) based on a value-chain framework that enables the systematic identification of demand-driven technologies and partnerships that are required to deliver impact at scale at the country level. This approach draws on past lessons from CGIAR projects that have scaled such as DTMA, STRASA, and Tropical Legumes 2. It also looks at the implementation of new tools for real-time reporting of progress to support agile course corrections, to strengthen linkages and feedback loops along the chain and to inform changes in priorities and approaches in response to emerging needs of development partners in service of realizing national goals around nutritional security, poverty alleviation and sustainable intensification. The DCLAS Impact Pathway and Theory of Change are presented in Annex 4, and the program’s framework for country engagement, strategy development and implementation is presented in Annex 5. While integrated, DCLAS is also modular along a value chain framework that will enable investors to target resources along components of the value chain, by geography or by commodity, if required.

It is important to note that the Theory of Change of the program takes into consideration important preconditions and assumptions that are central to the delivery of the IDOs. The most important precondition is that smallholder farmers adopt the outputs from Flagship Projects. Adoption of any technology is primarily driven by existing and emerging demand for the livelihood-system outputs, and secondly by the awareness and knowledge of the technology. Ongoing evaluation of demands and constraints are thus critical to enable planning and implementation of interventions for effective and sustainable delivery against the IDOs. Assembly, analysis and utilization of baseline data, through Flagship 1 (Priority Setting & Impact Acceleration), will be used for demand and constraint analysis, planning, priority setting, monitoring and evaluation, and impact assessment.

A second important precondition for the successful contribution of the program to the IDOs and SLOs is that our research outputs meet farmers’ and farming community requirements. Thus it is imperative that research interventions address local and regional preferences of dryland livelihood systems. Smallholder farmers vary according to production objectives, resource base, and their degree of aversion to risk, and broadly include poorer farmers that require research outputs for household food security, and better-off farmers that require outputs to access markets. Through its Flagships 2 (Pre-Breeding and Trait Discovery) and 3 (Variety and Hybrid Development), the program will focus its crop-improvement research on preferred and high-priority local and regional traits that address (1) yield enhancement and stability in the face of pest, disease, weed and climate-change constraints, and (2) crop-produce quality that aligns with local market needs. Productivity gains require both improved varieties and soil-crop-water management practices. Flagship 4 (Integrated Land, Water and Crop Management) will address this in alignment with other agri-food systems in the target regions.

Yet another precondition is that smallholder farmers have access to the outputs from the program. Seed of improved varieties is the central output from crop improvement efforts in FP2 and FP3. A ‘seed system’ is a broad concept for the technological, organizational, institutional, regulatory and policy framework within the variety-development, seed-production, seed-use continuum. Its overall performance and efficiency can be measured by the development of locally-adapted and farmer-preferred varieties, establishment of an efficient
seed delivery system and effective technology transfer. Seed delivery of open-pollinated varieties and hybrids will require engagement and partnership with public-sector organizations and private companies, respectively. We assume that the engagement of private seed companies will increase in Africa with the increasing demand for hybrid seed, and that seed regulations can be reformed to allow the sale of quality-declared seed. Flagship 4 (Seed Systems and Input Markets) will focus on seed systems, along with fertilizers and crop-protection inputs.

An important unclear consideration in technology development is its socio-ecological impact. Not all technologies are environmentally neutral or beneficial and the benefits to the user may be more than offset by their impact on other members of the community or future generations due to degradation of the natural resource base. This CRP will search for the best ways to manage the natural resources of the system while increasing farmer profitability and address the emergent properties of agricultural livelihood systems in order to avoid negative impacts of system interventions through its Flagships 5 and 6 (Integrated Land, Water and Crop Management; Improved Rural Livelihood Systems).

The last precondition is that there is an enabling environment for the dissemination and uptake of the outputs from the program. Access to outputs can be improved by a more favorable enabling environment. Governments may subsidize competing food grains (rice and maize) that penalize growers of dryland cereals and grain legumes, and enforce regulatory frameworks that prohibit the sale of quality-declared seed. Government policies may influence fertilizer availability and access, either via subsidies targeting specific crops, or via import tariffs, and distribution policies, that can lead to inflated prices, and delayed delivery. Flagship 1 will work in concert with Flagship 7 (Post-harvest Value Addition and Output Markets) and focus on analyses and interventions that can be contributory to providing an enabling environment. Flagship 7 will also work together with the Agribusiness Incubator Platform of the Lead Center to facilitate output-market access across the drylands for up scaling and out scaling of technologies from all of its Clusters of Activities.

**EVIDENCE OF DEMAND, PROGRAM FLAGSHIPS AND COMPARATIVE ADVANTAGE**

The complex social, economic, political and environmental factors confronting livelihood sustainability in the target dryland regions of the program call for an integrated and collaborative systems approach structured around the key commodities in these regions and where they are present, including dryland cereals, grain legumes and livestock, for efficient mediation of positive change. Lessons learned from the overwhelming inadequacies of isolated past efforts to address economic growth or food and nutritional security, and the emerging glimpse of real success through integrated efforts combined with national/regional support pave the way for a timely and informed intervention for change. The component dryland cereal and grain legume crops of the program cover a total area of roughly 147.68 million hectares in the target countries, where they form the basis of smallholder rainfed and irrigated agricultural systems that are highly linked to livestock enterprises in pastoral and agro-pastoral systems, and where they are mostly used as family food and animal feed or fodder. With prevailing child malnutrition at 27% in Africa and as much as 37% in India, the high-protein value of grain legumes combined with the micronutrient-rich calorific value of dryland cereals offer the opportunity for nutritional security in the challenging soil and climatic environments of the program’s target regions, where other agricultural commodities often fail to yield consistently. Significant yield gaps remain for these crops, especially in the target regions, due to both a chronic under-utilization of their genetic potential and diversity as yet, and a lack of improved crop varieties and best crop management practices. The threat of further soil degradation and consequent loss of agricultural productivity (Vlek et al 2008) make it imperative to focus on productivity improvement through an integrated land-crop-water management approach, facilitated by this new global partnership. The unique advantages of the CGIAR are: (1) the richest global genetic diversity for commodity crops, preserved in central germplasm collections for global use towards international public good, (2) the richest global network of partners and local implementation capacities and infrastructure across the developing world that allow the translation of the most innovative academic modeling tools and system research on the ground, and (3) local and regional socioeconomic data pools covering almost all Low Income Food Deficit Countries, collected and used for implementing and monitoring development impacts across the globe, combined with sophisticated tools and technologies enabling analyses...
and forecasting. The DCLAS alliance of seven CGIAR centers and their strategic partners for research and development (detailed in Annexes 6 and 7) taps into all three CG-level advantages to achieve the goals of this integrated program that spans commodity, livelihood-system and market research, and that is built on the learning of its component programs.

**FLAGSHIP DESCRIPTIONS AND STRATEGIC FIT OF PARTNERS**

Information on the ongoing W3 and bilateral projects of the Lead and Partner CG centres presented in Annex 6, and the CRP-CRP partnership possibilities identified in Annex 7, strengthens the strategic roadmap of DCLAS to achieve its IDOs and sub-IDOs through its seven different flagships described below.

**Priority Setting & Impact Acceleration (Flagship 1):** This Flagship addresses baseline-data management, foresight planning and priority setting to enable demand-driven R4D focus and impact assessment, and contributes towards productivity, nutrition and income. Gender is a cross-cutting activity in this flagship and is integrated into all of its planned outputs. The collection and analyses of baseline data for the target crops as relevant to the target regions has been an ongoing activity during the first phase of the component programs through two important bilateral projects. Assembly of the available data and synthesis of results, together with identification and rectification of existing gaps in base-line information is a top priority for the component programs during the extension phase. Additionally, GIS data, collected or in the process of collection, will be used to predict future dryland-cereals and grain-legumes geographies arising due to climate change. **Foresight planning and priority setting** efforts will use the assembled baseline data to identify critical areas of focus for research investments, partnerships and interventions in the other Flagships. The integrated modeling framework developed under Policies, Institutes and Markets (PIM) will be used to analyze various plausible future scenarios to identify those technologies and management systems that will contribute most to the achievement of the IDOs. **Adoption surveys and impact assessment** will be conducted to monitor the level and pathways of adoption, and to measure the changes in selected outcome and impact indicators. The feedback generated from these surveys will facilitate better targeting of crop-improvement, crop-management, livelihood and market interventions. **This Flagship will address the SRF IDOs B-1, C-1, and D-1.**

**Crop Improvement (Flagships 2 and 3):** An **innovative introduction** in Phase II for Flagships 2 (Pre-Breeding, Trait Discovery and Development) and 3 (Variety and Hybrid Development) is the organization of the Clusters of Activities of the two flagships along four different stages of a variety/hybrid development pipeline which envisions and streamlines **data-driven annual gateway decisions for germplasm advancement** from one Stage to the next, with accountability of delivery incorporated into the Performance Matrix at all levels. **Country-wise trait targets** will be informed by the present understanding of target production systems, and a refinement of these priority traits is a continuous activity. Breeding programs that address sufficiently **large numbers of genotypes evaluated across multiple environments** are central to progress in crop improvement, through both conventional methods and modern genomic tools. Targeted development of **genomic resources** and **testing sites** will be undertaken in collaboration with international initiatives. The genotyping data that is already available will be leveraged together with phenotyping data for genome-wide association studies, allele mining and marker identification, using new bioinformatics support through BMGF and CGIAR. We will also interact with the Integrated Breeding Platform for the development and implementation of breeding services for marker-assisted selection. Further, **crop models** will be calibrated for the different crops, target environments and management conditions in order to define target populations of environments and specific physiological parameters for breeding towards appropriate ideotypes.

The establishment of methods for defining parental heterotic groups is critical for building **distinct and complementary parental pools** for effective and sustainable hybrid breeding. Analysis of combining ability and examination of genetic diversity for pertinent ranges of germplasm will be important outputs. The development and/or application of breeding technologies such as **doubled haploid induction** and **genetic male sterility** in elite parental lines will be useful for creating and exploiting genetic diversity. Flagships 2 and 3 will provide feedback information to Flagship 1, and knowledge and germplasm to FP4, FP5, FP6 and FP7. **This Flagship will address the SRF IDOs 1.1, 1.3, 1.4, 2.1 and 3.2.**
Seed Systems & Input Markets (Flagship 4): Region-specific information on market demand for seed of dryland-cereal and grain-legume OPVs or hybrids is scattered, which makes it difficult to determine the types of products to be developed, or to identify farmer response to the range of products under development. We intend to combine seed-system analyses and country case studies along the ‘seed value chain’ to identify systemic bottlenecks, and facilitate the formulation of robust policies and strategies for specific country situations. We will also conduct an industry mapping of actors in the input value chain (seed and fertilizer) to understand key constraints, challenges and strategies to overcome gaps, as well as policy and infrastructure issues in input supply and delivery systems. In sub-Saharan Africa, feasibility studies are required to identify the most appropriate impact pathways and the commercial opportunities for private seed companies. Such evidence-based analyses will enable advocacy for the development of formal and private seed sector for our commodity crops. Linkages with the private seed sector are very critical to the transfer and commercialization of technologies from lab to land, as the private sector is closely associated with farmers and end users, and can play a vital role in understanding customer needs and priorities. DCLAS will lobby for change on seed policies through umbrella groups such as ASARECA and CORAF/WECARD. Areas of importance include harmonized varietal release policies, acceptance of quality declared seed or truthfully-labelled seed as a legal seed class, and reform of national seed laws.

A framework for fast-track variety release and accelerated seed multiplication will be advocated to strengthen NARS to ensure regular supply of basic (foundation) seed. Small-pack seed distribution will continue to be popularized to support smallholder women farmers and to create awareness of new varieties. Functional seed units with adequate access to physical, human and financial resources will be supported or established to overcome critical gaps in foundation seed production by the NARS. These activities will be linked to large-scale certified-seed multiplication, by partnering with existing public seed enterprises, emerging private seed companies or existing/newly formed small-scale enterprises wherever a formal seed sector is absent. These efforts will be augmented by stronger capacity development of partners including NARS, seed producers, agro-dealers and farmers. This Flagship will address the SRF IDOs 1.2 and 1.4.

Integrated Land-Water-Crop Management (Flagship 5): Lack of good soil- and water-management practices or mismanagement threatens soil health and environmental sustainability, as evidenced by declining soil-carbon reserves and multi-nutrient deficiencies in dryland regions. Therefore, building the resilience of dryland production systems depends largely on soil health and water-management practices. This flagship focuses on interventions of crop-soil-water management at the watershed-catchment level to enhance the productivity and adaptability to environmental variability of the component crops. Extensive soil mapping and balanced fertilizer recommendations through micro-dosing, and harnessing the benefits of biological nitrogen fixation will be important focus areas for soil management, along with waste recycling and biomass generation, where possible, for the reduced use of chemical fertilizers and the development of sustainable systems. On the water-management front, dryland-cereals and grain-legumes production will be linked with in-situ and ex-situ water-management options including micro-irrigation and better targeted supplementary irrigation through synergistic efforts with WLE. The success of the Bhoochetana initiative for improving crop productivity and livelihoods in Karnataka, India, provides a model that can potentially be tailored and out-scaled to other parts of Asia and Africa for enhanced productivity and environmental sustainability. Crop-management practices including seed treatment, integrated insect and disease management and other required agronomic practices will be promoted for higher productivity of dryland cereals and grain legumes. Mechanization of farm operations for reduced production costs and enhanced efficiency will be addressed for sustainable intensification of dryland-cereals and grain-legumes production. Finally, climate-information services will be utilized to enable farmers to take ameliorative measures against climate aberrations to minimize production losses and optimize resource utilization. This Flagship will plan joint research with Flagship 2 to ensure that varieties and hybrids integrate the newly proposed management practices. This Flagship will address the SRF IDOs 1.4, 2.3, 3.1, 3.2 and 3.3.

Improved Rural Livelihood Systems (Flagship 6): Improvement of smallholder livelihoods depend upon the interconnections among different components of the farming and livelihood systems, especially the environmental, institutional, gender and equity-related dimensions of livelihoods, and the trade-offs, non-

DCLAS PRE-PROPOSAL
linearity and tipping points of biophysical and socio-economic processes. Flagship 6 focuses on these interconnections and will develop new combinations of crops, trees and livestock options, together with tools, simulation and trade-off models that will increase the productivity, resilience and diversification of livelihood strategies. Better targeting of interventions requires an understanding of the system context and the extrapolation domains. These include the market opportunities which are key drivers of change in rural societies (with FP7). Markets determine the interactions amongst the components of farming systems, and households face challenges to participate in and benefit from markets as producers and consumers of agricultural products. An enabling environment is key to the success of interventions, and this flagship will identify, implement and test with partners’ innovations that address the behavioural, social, institutional, governance, economic and ecological barriers to success and upscaling. This will include the costs and benefits of interventions in terms of the overall economics of changes in land use, practices and ecosystem services and relate them to alternative livelihood options that dryland populations engage in. These can be agriculture and non-agricultural activities such as payment for stewardship of landscapes, tourism, etc., that characterize the livelihoods of dryland communities. An indicator framework to monitor trends in rural livelihoods and their typologies will be developed to aid targeting of interventions. The flagship will deploy the outputs of the other flagships in this CRP and will collaborate with PIM and WLE, in particular, on land-use issues. **This Flagship will address IDO’s 1.1, 1.3, 1.4, 2.1, 3.1, 3.2, 3.3, A-1, B-1, C-1 and D-1.**

Post-harvest Value and Market Access (Flagship 7): To create demand-driven adoption, this Flagship will address (1) value chain analysis, (2) regional trade, (3) pilot value-chain incubators, and (4) reduced post-harvest losses. Gender analysis is a cross-cutting activity in this flagship, as in all others, with leadership through Flagship 1, and it is critical for ensuring that the benefits from improved market access and post-harvest value addition flow equally to women and men. We will identify ‘best-bet’ dryland-cereals, grain-legumes and integrated crop-livestock value chains that have high growth potential and the potential to raise incomes for poorer smallholders through the stimulation of regional trade and regional specialization in crop and livestock production in drylands. Leveraging the experience, networks and partners of the Agribusiness Incubation Platform at ICRI SAT, value-chain incubators will be piloted for the integrated crop-livestock options in one or more of the target regions. The pilot envisions strengthening and/or filling weak and missing links in dryland crop-livestock value chains in the target regions. Efforts to reduce post-harvest losses will include assessment of post-harvest losses from insects, rodents, molds and other sources, and management to reduce severity. Poor storability of flours from millets under humid conditions due to rancidity is identified as a research target for breeding and processing technologies in regions where the problem is severe. Poor seed quality resulting from overheating during drying, molds, insect damage etc, is also of concern, and proper management practices will be promoted to improve germination and plant stands. DCLAS will leverage its partnerships to improve the quality of stored seed, grain and flour. Further, commercialization requires mechanization to cope with increased harvest volumes and to improve grain quality. The feasibility and profitability of small-scale mechanization for dryland farm operations will be evaluated based on experience at field level to assess market demand, and linkages will be made with private engineering firms to promote adoption. **This Flagship will address SRF IDOs 1.2 and 2.2.**

STAKEHOLDER COMMITMENT
The integration of systems research within and beyond target-crop improvement, and the strategic partnerships of three previous CRPs (Dryland Cereals, Dryland Systems and Grain Legumes) that have come together for unified implementation for impact at scale, allows us the unique opportunity to facilitate developmental outcomes for livelihood improvement at the farm level and beyond. The program derives its strength from stakeholder commitment at the global level all the way to the local level, through (1) alignment of its goals to the IDOs and sub-IDOsof the SRF that in turn map to the UN Sustainable Development Goals, (2) alignment of its strategy with national and regional priorities through consultations with national governments and NARS partners, (3) alignment of its implementation with strategic public and private sector partners with shared goals and vested interests who can fill existing gaps in technological or developmental capabilities and infrastructure of the program, and (4) alignment of its gender, youth and capacity development efforts towards strengthening of the knowledge and infrastructure of national partners for
sustainable agricultural development. During the months of March and April of 2015, Dryland Cereals, Grain Legumes and Dryland Systems conducted planning meetings in preparation for Phase II that involved all key stakeholders, to inform the development of the Phase II proposal. For the next step of proposal development, we are geared to participate in the CGIAR country-level consultations planned for Q3-2015 that are intended to advise site-integrated CRP implementation in selected countries. Further, ongoing national-level discussions strengthened by historical partnerships of the participating centers (eg., Ethiopia, India, Morocco, Nigeria) are feeding into the prioritization of implementation plans of DCLAS. Finally, recognizing both our strengths (germplasm diversity, national/regional networks) and limitations (high-end tools and technologies including modeling, high-throughput production facilities, big data management) we have established newer partnerships across public and private inter/multinational organization, such as the UNCCD, DuPont Pioneer, Syngenta Foundation, Chromatin Inc. and others. Current and potential future partners of DCLAS include other CGIAR research programs and centers, national agricultural research institutes and their sub-regional coordination organizations including CORAF/WECARD and ASARECA, advanced public and private research institutes, non-governmental organizations, civil society organizations, farmer unions, governments and their donor-funded agricultural development programs, and private enterprise. Partnerships will be implemented through specified budget allocations to partners from the overall budget of DCLAS, competitive or commissioned grants on invited proposals contributing directly to the outputs from the program, and the sharing of resources, knowledge and expertise amongst partners.

Beyond developing partnerships as part of the research and development activities, DCLAS will directly include partners in the management and oversight of the program. The Steering and Advisory Committee, and the Core Team of the Research and Management Committee of the program will include representatives from the private sector, ARIs, donor-stakeholders and national/sub-regional coordination organizations. Such involvement in the oversight and direct research management of the program is seen as vital to create momentum for the new partnerships designed for the program. As indicated in Annex 7, DCLAS will establish collaborative relationships with other CGIAR research programs where strong synergies exist, as with the Global Integrative Programs, namely, Policies, Institutes and Markets (PIM), Agriculture for Nutrition and Health (A4NH), Climate Change, Agriculture and Food Security (CCAFS), Water, Land and Ecosystems (WLE), as well as with other agri-food system programs, importantly Livestock, Maize, Wheat and Rice. DCLAS also expects to play a key role in mainstreaming systems approaches into the CRP and others via the suggested modalities prepared at the Montpellier meeting of June 2015.

Citing limited examples from the strategic partnership list identified in Annex 6, the component programs of DCLAS already work hand in hand with EIAR, Ethiopia; ICAR, India; INRAN, Morocco and others to meet challenges in the production of dryland cereals and grain legumes in South Asia. The USAID-supported Feed the Future Innovation Labs associated with Dryland Cereals and Grain Legumes will contribute their expertise in the genetic enhancement of these crops through genomics, bioinformatics, physiology, and breeding materials in Ethiopia and West African nations. The Pearl Millet and Sorghum Hybrid Parents Consortia established by ICRISAT in 2000 provides effective dissemination of improved research products to the farmers and will be used as a model for establishing similar entities in Sub-Saharan Africa, once a sizeable private sector gets established. Close collaboration with agricultural development initiatives to facilitate farmers’ access to fertilizer and more labour-efficient agricultural equipment will provide synergies for production increases. Also, linking producers with processing industries and large-scale grain market players will be essential for developing a growing demand for specific and uniform qualities – a specific advantage from hybrids. Monitoring and communications activities of DCLAS will rely on collaboration with farmers’ organizations, development actors, and rural radio networks for successful and wide coverage. The component programs already involve joint research with CIRAD, the University of Queensland, EMBRAPA, Cornell University, the University of Georgia and the University of Hohenheim. A strong partnership is operating with the University of California, Davis targeting drought tolerance, high productivity, disease resistance and malting quality.
**GOVERNANCE & MANAGEMENT**

The component programs of DCLAS have transitioned towards the IEA recommendation to “create a single, balanced governing body for each CRP that reports directly to the lead center board on the performance of the program. The CRP governance body should bring together appropriate expertise, include a majority of independent expert members, and accommodate lead center and partner representation.” We plan to have in place, by Jan 2016, a new Steering and Advisory Committee from representatives of the current individual programs for a seamless transition to Phase II in Jan 2017, if approved. Limitations to program efficacy due to existing governance and management structures have been identified and recommendations have been provided by (1) the separate ‘CRP Commissioned External Evaluations’ of Dryland Cereals, Dryland Systems and Grain Legumes, and (2) the CO Internal Audit of Dryland Cereals and Grain Legumes. The relevant CRPs and Centers have taken these recommendations on board and are in the process of developing policies and putting in place processes for serious revisions in the existing structures for governance, management, and budgeting to improve the effectiveness of the reform process and to provide the CRP Director the authority to manage for accountability. Guidelines for the governance and management of the program are provided under Annex 8, and the proposed new CRP governance and management structure, according to IEA guidelines, is presented in Annex 9. Some of the key lessons learned in Phase I include:

- Lack of clarity in roles and responsibilities are leading to reduced effectiveness, as is the lack of authority for the CRP Director to manage for accountability.
- The importance of results-based-management in positioning for program success has become very obvious, and the Monitoring & Evaluation platform of the component program, Dryland Systems, will be adapted for DCLAS. The draft Monitoring, Evaluation and Learning policy for the program is presented in Annex 10.
- Program success requires (1) seamless integration between flagships that are organized along a delivery pipeline, and (2) utilization of feedback loops in the Impact Pathway.
- Significant achievements remain unpublished, thus reducing visibility to the research and development accomplishments of participating Centers and partner institutions. At the same time the importance of science quality cannot be overemphasized.
- Increased attention to implementation focus and distributed responsibilities for practical implementation among partners can help manage workloads better and accelerate the path to impact.

**BUDGETING AND VALUE FOR MONEY**

The drylands, home to approximately 2.5 billion people, constitute the world’s most challenging living environments with harsh climates, poor soil conditions, and social and political volatility, together presenting a development challenge that produces, relative to other regions, lower value per dollar of R4D investment. At the same time these are the most critical areas for global R4D investment to support livelihood improvement. Understanding the nature of the challenges and opportunities in their entirety, and planning and executing in collaborative partnership with stakeholders are critical to success. The potential risks are described in Annex 11.

The budget formulation for the program is based on the approved total 2016 budget for the extension phase of the component CRPs, Dryland Cereals, Dryland Systems and Grain Legumes, capturing all possible synergies and efficiencies in management, R4D operations, partnerships, gender, youth and capacity development. Budget distribution across the flagships is proportionate to current and foreseeable future activities and capacities of the program to achieve impact at scale. The overall synthesis of the budget and the details of arriving at the current combined annual budget of $136.6 MM from the proposed 3-CRP total annual budget of $145 MM are presented in Annex 12. The Performance Indicator Matrix (PIM) is presented at a high level with more granularity at the example country-level PIMs, presented in Annex 13, for Ethiopia, Nigeria and India, that present more definition towards activities and outcomes. It is critical that behavioural changes toward accountability are facilitated at all levels of implementation for performance towards agreed outcomes.
Gender, Youth and Capacity Development

Budget for management and administration will cover the expenditures of the program management unit, as well as the amounts for (1) gender and youth, and (2) capacity development. Use of dryland cereals and grain legumes in food, feed and fodder in smallholder dryland agriculture involves women at all stages of crop production and post-harvest processing. The reference to groundnut, sorghum and millets as “women’s crops” in Africa highlights the dependence of women in smallholder farming communities on these crops. DCLAS recognizes that crop improvement, management, post-harvest interventions and livelihood improvement require careful consideration and incorporation of the preferences and constraints of women farmers, and the planned and approved Gender Research Strategies of the component programs address this requirement.

Capacity development efforts will be scaled up from existing baselines, and the scope of short-term training sessions will be enhanced to cover the various parts of the value chain for the dryland commodities, but with renewed emphasis on newer tools and technologies for crop improvement, bioinformatics and data management. In addition, the ongoing Scholarship Programs of the component CRPs, Dryland Cereals and Grain Legumes will be strengthened and modified to address a composite dryland research program, together with our target grain legumes in other ecologies. Finally, DCLAS will adopt the Youth Strategy developed by Dryland Systems which aims to engage youth in creating their future in agriculture by benefiting from dynamic, innovative agricultural development processes that enhance access to and control of agricultural assets, technologies, services, products and income, and decision-making power in dryland livelihood systems. This leads to improving the status, influence and commitment of young farmers, agro-entrepreneurs, and professionals to develop profitable farm, agriculture-related and agro-processing enterprises, and service enterprises that are environmentally and economically sustainable and socially just. The Capacity Development Strategy of the program is presented in Annex 14, and the youth strategy of Dryland Systems, which will be followed by DCLAS, is available here.

The CVs of the writing team are presented in Annex 15. Our response to the SPPC review comments is presented in Annex 16, while responses and actions towards addressing ISPC comments listed in Annex 17 regarding the first and extension phase proposals can be accessed here. The overall Performance Indicator Matrix is presented in Annex 18.
PART - II
FLAGSHIP 1: PRIORITY SETTING & IMPACT ACCELERATION

RATIONALE
Achieving impact at scale through innovative research that delivers development outcomes is a crucial ambition of DCLAS. Flagship 1 (FP1) is designed to support the program and its stakeholders in achieving this. It will do so through a combination of foresight and learning to set priorities and align research to demand in areas with the highest expected impact (Fig. 1). The overall objective of FP1 is to ensure that DCLAS research is demand-driven, outcome-focused, with high impact, inclusive (gender, youth, poor and disadvantaged), development-relevant and scalable. Building on achievements in phase 1, FP1 will compile and collate evidence and support learning on options with the greatest development outcomes for various contexts. The FP will facilitate these processes with researchers across FPs and other actors in drylands agriculture and development. FP1 will host a critical mass of expertise and knowledge to help DCLAS achieve the balance of innovative and demand-driven research that will accelerate the delivery of development outcomes.

Grand challenges in drylands
The principal grand challenge is how to overcome the inherently low productivity and profitability of dryland agriculture and manage the high risks faced. Underlying root causes of these include low and irregular rainfall, neglect, remoteness, etc. Anticipation and learning are crucial social processes in dryland development, e.g. the capacity to anticipate and respond early to adverse events, and to learn from events that occur. They support stakeholders to recognize and address the risks related to volatile climate, markets and social conditions as well as to scarcity and degradation of natural resources that are obstacles to agricultural intensification. Anticipation and learning are also important in understanding and mitigating these risks and to strengthen the resilience of agricultural interventions, such as improved germplasm, seed supply systems and soil, water and crop management. The second grand challenge is reconciling the seemingly conflicting objectives of resilience and sustainable intensification. These two concepts are covered by two largely separate bodies of academic literature; the challenge is to bring the two partially conflicting agendas together. This FP can make a difference here, and we will approach this through a collaborative multi-stakeholder effort. The third grand challenge is the potential conflict between addressing global issues such as climate change, land degradation and pollution, and local, urgent, personal problems related to poverty. How to resolve this tension, in general and specifically, is a major question for this FP. Finally the challenges of neglect and remoteness that constrain the adoption of agronomic techniques and a greater role of market orientation and
private enterprise in achieving development outcomes need to be addressed. Modern digital technologies have the potential to meet these challenges and contribute to better communication and learning, and we will explore this.

**Issues to be addressed:**
The issues to be addressed by FP1 are introduced together with examples of overarching research questions.

**Prioritization and learning:** Innovative methods and approaches for priority setting are required in order to better prioritize and design interventions and facilitate learning that take account of stakeholder engagement in a risky and uncertain environment, e.g. envisioning desirable futures, the options to get there and the anticipated outcome of interventions. The rationale behind this thrust is that development is characterized by far too many failures, many of which can be avoided through participation of relevant actors and inclusion of feedback loops for learning. Starting from work undertaken in the past at global and national level, this activity will work on ways to develop and identify participatory, inclusive and better grounded interventions. - *What are the desired (by different stakeholders) sustainable development outcomes in the target areas dominated by dryland mixed crop-tree-livestock systems and characterized by vulnerability to multiple risks, shocks and stressors, and what are the plausible sustainable development outcomes under different future scenarios (e.g. 2030)?* - *How can we provide the evidence and relevant risk/reward information to end users in a form that is easy to understand, interact with and use?*

**Value chain development in dryland systems, demands and constraints.** Dryland regions are often quite remote from major urban centres and value chain development is hindered by poor infrastructure and institutional barriers. Growing demand for healthy food options by urban consumers opens niche markets, and is also a potential driver of change because traditional dryland cereals and legumes offer high nutritional values. In order to facilitate change, value chains that offer the best potential for inclusive growth and benefits to the target population needs to be addressed. - *What value chains have the highest potential for nutrition, economic growth and social inclusion?*

**Climate change impact analysis and strategies for adaptation in drylands.** The limited resource base of communities in dryland areas makes them particularly vulnerable to climate change, irregular weather patterns and extreme events. This requires in-depth, focused analyses of the implications of climate change taking into account the characteristics and variability in dryland agri-food systems. The impact of climate change and variability and potential adaptation options for drylands need to be better understood to reduce risks and shocks (extreme events). - *Which set of new technologies would have the greatest impacts on food and nutrition security and poverty reduction in the dryland systems under climate change?*

**Inclusive innovation systems and learning.** Ensuring equitable inclusion of women and young people in dryland agriculture, including on- and off-farm value addition, and in natural resources management are crucial. Inclusive innovation systems and learning can form the vehicle for transformative change creating opportunities for women, young people and marginalized groups in drylands regions. Our hypothesis is that, besides being a development goal in itself, empowering women and young people is the leverage point for positive change and development in these farming communities. - *What can be the role of inclusive innovative learning and action systems in bringing gainful engagement of the young people into dryland agriculture?* - *Which are the bottlenecks and trade-offs in women’s participation in agricultural value chains in drylands (e.g. related to resource availability, non-monetary aspects), and which role can inclusive innovative learning and action systems play to leverage change?*

**Drivers of adoption and enabling environments.** Understanding smallholder livelihood diversity is crucial for adoption and scaling of innovations and technologies and will add value to the analysis of adoption constraints undertaken under phase 1 (Dryland Systems, Grain Legumes and Dryland Cereals). However, it is still lacking, especially in the drylands. The policy environment as a key determinant of success has to take diversity into account by avoiding a uniform and prescriptive approach to drylands development. By facilitating an improved match between end-user demand and new or existing technology options, outcomes can be improved, further
income can be generated and employment opportunities may arise, depending on the technologies’ characteristics. - What are the underlying preferences affecting demand for agricultural technologies across the various target groups and how can these be used to enhance adoption? - What are the policy processes and enabling factors underlying effective uptake of new technologies in dryland systems and how can these be supported efficiently and effectively?

Uptake of technologies, adoption, impact and scaling
To support innovation development the uptake and adoption of technologies (options) have to be assessed at the implementation sites to guide the research process. Aiming at impact at scale the options need to be tested across a range of contexts (type of households, communities, agro-ecologies, social and political environments) in order to generate evidence of potential impacts at scale. - What characteristics of dryland agri-food systems are enabling or constraining technological, policy, institutional and market options and how do these relate to livelihoods and sustainability in different contexts? - What are the social structures, including gender, age and wealth dimensions that influence technology choices and uptake, resource use patterns and market access?

Comparative advantage – FP1 will host a critical mass of researchers to serve DCLAS to achieve innovative and demand driven research that accelerates delivering development outcomes. FP1 will support DCLAS to address the risks in drylands explicitly while linking to the global CRPs (PIM, CCAFS, WLE, A4NH) and it will serve as a vehicle for inclusive priority setting, creating synergies between research activities and accelerating the delivery of outputs (including IPGs). It will also enable demand-driven outcomes of all FPs that can contribute to impacts at scale, with due attention to socio-economic (gender, age, culture, wealth), geographic and agro-ecological priorities and distributions.

CLUSTERS OF ACTIVITIES (CoA)
CoA 1.1 FORESIGHT, PRIORITY SETTING AND LEARNING
DCLAS will conduct inclusive, demand-driven research that is in line with farmers’ needs, local and national priorities, the SDGs and the CGIAR’s strategic objectives (SLOs, IDOs). By working closely with other DCLAS FPs, CoA1.1 will contribute to this by foresight studies and facilitating stakeholder (e.g. farmers, policy makers, development agencies) awareness and engagement processes to elucidate perspectives and desired outcomes, as well as context-specific assets, constraints and opportunities that influence decision making. The analysis will add to research undertaken during phase 1 in close collaboration with the Global Futures project (PIM) and enhance the priority setting by adding further dimensions which will improve the targeting and impact. Furthermore, studies of demand in multiple target countries have been undertaken and will further add to the full picture to be considered to set priorities for DCLAS. The results will be jointly used to guide DCLAS’ research agenda. CoA1 will also contribute to the option development process by building on existing evidence and modelling of the likely outcomes of particular innovations and approaches. We will work with stakeholders to test and negotiate options to achieve their articulated desired outcomes. Projection approaches will be based on intervention impact pathways that are developed through participatory processes that take into account risk and uncertainty and differential impacts across stakeholder groups. CoA 1.1 will be a key component in FP1’s impact pathway; it will make a major contribution to building bridges across FPs as well as between DCLAS partners and beneficiaries It will further raise the impact prospects of DCLAS’ research by ensuring that stakeholders have negotiated the options investigated by DCLAS and by equipping them with credible risk-informed impact projections of decisions and the resources needed to promote and implement these options.

CoA 1.2 VALUE CHAINS, DEMAND AND CONSTRAINTS
The target population of DCLAS is often engaged in subsistence production and only markets a share of their products. Nevertheless, households rely on various value chains to access inputs and meet their cash income demands from the marketed share of production. These existing value chains offer great potential for inclusive

---

1 These are some examples while a more comprehensive book has been accepted for publishing with CABI.
growth of the sector, for enhanced profitability and for participation of poor marginalized people in the value chains of drylands products. In dryland regions value chain development is often hindered by poor physical infrastructure and institutional constraints, especially in remote areas households face serious constraints as highlighted in various value chain studies in phase 1. Women face further barriers related to culture and norms, besides time constraints due to their productive and reproductive responsibilities. Against this background, critical questions emerge regarding which value chains offer the best potential for inclusive growth and the highest level of benefits to all social groups in the target population. The aim of this cluster is to identify value chains that have strong potential to benefit dryland farming households while ensuring social inclusion. As the envisioned outcome of the value chain priority setting is enhanced market participation to reduce poverty, the criteria selected have to reflect both economic factors – to ensure sustainable business models – and social considerations. These will include strong marketing prospects for the product, scaling potential, representation of the various social groups and the number of poor people involved in the chain. To quantify consumer demand across different regions a synthesis of studies will be used to identify the most promising chains which are or could be accessible to dryland farmers and identify the key demand. Growing demand for healthy food options by urban and peri-urban consumers will receive specific attention for its role as profitable niche market but also as a driver for longer term changes in eating habits by the whole population as experienced in developed markets over the past decade. Traditional dryland cereals and legumes, especially, offer superior nutritional value over current food options and are largely produced by smallholder farmers, so that strengthening these value chains is expected to generate pro-poor outcomes for the dryland farming population.

**CoA 1.3 CLIMATE CHANGE IMPACT ANALYSIS**

Dryland communities are particularly vulnerable to climate change (CC), irregular weather patterns and extreme events, necessitating in-depth and more focused analyses of implications of CC that take into account the uniqueness of the dryland agri-food systems. Because these mixed systems are very complex and variable (in terms of bio-physical and socio-economic conditions), the use of participatory methods and simulation models is proposed for ex-ante impact assessment of CC and variability and potential adaptation options (with FP6). In these analyses we will make use of new developments in rule based decision modelling that go beyond standard bio-economic optimization approaches, and thereby allow for a more holistic assessment of future development pathways for dryland farming systems and their communities, and how adaptation options can help to deal with climate variability and change. This cluster will collaborate intensively with CCAFS, and will make use of the body of CCAFS work developed in recent years: especially the toolkit of production-oriented models, for example existing work on ex-ante impact assessment of climate smart agricultural (CSA) practices and portfolio’s, household and community level baseline datasets, the regional future scenario work, and the CGIAR presence in the ‘climate smart villages’ will allow for a rapid start of the research. Special attention will be given to the operationalisation of resilience frameworks in relation to climate variability. A participatory approach will be followed to identify key indicators that are meaningful to the local communities in terms of food security and economic performance. Adaptation options identified in the other clusters will be evaluated on their capacity to increase the buffering and recovery capacity at farm household level.

**CoA 1.4 EMPOWERING WOMEN AND YOUNG PEOPLE THROUGH INCLUSIVE INNOVATION SYSTEMS**

When innovations that improve agriculture, on- and off-farm value addition, and natural resources management are deployed to communities, not all social groups derive the same level of benefits from them. Social exclusion factors, sometimes embedded in culture, norms and/or institutional organization, are not well understood and considered in innovation deployment processes. This can lead to interventions providing disservices to certain social groups. Participation in value chain development is often contingent on power and social or political connectedness that usually women and youth do not have. These obstacles to inclusion are particularly pronounced in remote communities, in which connections are difficult to establish and often poorly developed. CoA1.4 will address empowerment of women and young people as ‘social categories’ in dryland livelihood systems and the strategic questions of how communities are structured, the gender gaps that result from community structures, and the systemic factors/drivers of change, that would lead to empowerment/disempowerment of these social groups. CoA1.4 will also consider the over-arching question
of how best to engage the youth in dryland agriculture through innovation systems bringing efficiency to the value chains and gainful engagement. The cluster will evaluate women’s participation in agricultural value chains, considering the resources available to them and the non-monetary trade-offs they make in adoption of technologies decisions. Adaptive models/agendas for ‘inclusive innovative learning and action systems’ as demand driven and participatory platforms for women and young people in agriculture will be developed and implemented together with national and development partners. The model will be based on the results of analysis of women and youth typologies in the targeted areas integrating knowledge and practice on the best bet technologies from other DCLAS FPs. The agenda[s] for the inclusive innovative learning and action platforms could be the same or different for the youth and for the women in a specific area. The process and functioning of the inclusive innovative learning and action platforms to deliver development outcomes and impacts through technology adoption and/or value chain development will be the focus of this activity. Empowerment of women and youth leading to increase in income, assets and resources (i.e. reducing poverty), increase in agricultural productivity, enhanced food and nutrition security and improved natural resource management and ecosystem are expected outcomes. CoA1.4 will contribute to create opportunities for women, young people and marginalized groups in drylands communities by emphasizing equitable access to resources, information and power in the livelihood systems.

**CoA 1.5 DRIVERS OF ADOPTION AND ENABLING ENVIRONMENTS**

The final aim of the research process is widespread adoption of effective technologies to achieve large scale impact and thereby reap the development benefits of the total investment in research. However, successful scaling of any technology requires a detailed understanding of the drivers of, and constraints on, adoption and a careful consideration of the target group(s) in order to reach the intended outcome. Adding to the analysis of target group segregation in market- and subsistence-oriented farmers, deepening the understanding of the end-user’s demands for technology attributes and resulting benefits is the key to any success and what makes an effective technology an attractive one to rural households. While the importance of DCLAS crops in the dryland farmers’ cropping portfolio has been established, understanding further dimensions of smallholder livelihood diversity is still lacking. The policy environment which can support or hinder effective dissemination and adoption is a key determinant of success. In order to avoid a uniform, prescriptive dissemination approach, this CoA will provide an in-depth picture of the characteristics of households (link to FP6) and circumstances in which the benefits of various available technologies are likely to be realised, together with the most appropriate scaling methods to achieve impact. By facilitating an improved match between end-user demand and research supply, outcomes will be improved and further income generated or employment opportunities arise depending on the technologies’ characteristics. Furthermore, the information requirements, dissemination channels and enabling policies will be analysed against this diverse background to provide appropriate feedback to other FPs and identify development partners that have the most appropriate skill set and institutional arrangements to facilitate dissemination and adoption at scale in the target locations and beyond. While these challenges are especially great in drylands, coordination with FTA, Livestock and other AFS CRPs will create synergies and complementarity. PIM will be a valuable partner in the area of policy analysis looking beyond the DCLAS crops and regions.

**CoA 1.6 MONITORING, IMPACT ASSESSMENT AND SCALING**

The purpose of CoA1.6 is (i) to support innovation development, assessment, and scaling processes across DCLAS FPs, (ii) to facilitate CRP-wide impact focused learning (ME&L), and (iii) to generate evidence of DCLAS’ impacts and its contribution to the IDOs and SLOs. Much of the research effort will be devoted to developing innovations (options) in a number of critical areas to bring about positive change in drylands mixed crop-tree-livestock livelihood systems. CoA1.6 will specifically facilitate the option development process through designing and carrying out (with other FPs) rigorous efficacy studies of the impacts of promising innovations on various outcomes, such as crop yields, household income, food and nutrition security, and empowerment. While these tightly controlled studies will possess high internal validity for the research process, they will have lower external (development) validity due to their localized nature. To address this challenge and as one key component of the scaling process, the performance of devised options (from FPs across DCLAS) will be tested at larger scales and across heterogeneous conditions. Much of this will take place in the context of larger scale
development programs in collaboration with development partners. Supporting option performance evaluation within such programs will have the benefit of enhancing program learning and effectiveness and generating robust evidence that can be fed back into the option development process (across DCLAS flagships) and/or scaled up and out. In addition to spearheading such research-in-development efforts (collaboration with FTA), CoA 1.6 will also pursue more conventional impact assessment and cost effectiveness/benefit studies, as part of a concerted effort to rigorously identify what works, where, for whom, how, and at what cost. Theory-based evaluation approaches and mixed methods will be used to maximize learning. Both the research-in-development and impact assessments will generate important evidence relevant to improving conditions in such systems, which will be used to support the second component of CoA1.6' scaling agenda. Here, work will take place with partners to influence key decision-makers to both uptake and promote options developed and tested under DCLAS, and create policy and institutional conditions conducive for facilitating such uptake. The final focus will then be to estimate DCLAS’ overall impact by both critically assessing how it has influenced wider policy and practice and monitoring the wider uptake of proven options and extrapolating the corresponding impact.

SCIENCE QUALITY AND NOVELTY
Several methods have been devised and proven useful to discuss the future in a structured and scientifically organized way and to create and share pictures of the future. With a set of possible future scenarios as the starting point, the preparedness for tomorrow’s challenges will increase and make it possible for different stakeholders to actively take part and shape their future. In turn this will help researchers to formulate cutting-edge research questions based on knowledge gaps and demand, and guide policy makers and funding bodies to support future oriented research. FP1 will build on this approach and also seek collaboration with the PIM and CCAFS. A novel approach to be used for stakeholder engagement in priority setting and scaling is the SHARED process, Stakeholder Approach to Risk-informed and Evidence-based Decision-making, a demand driven, tailored and interactive engagement process for collaborative learning and co-negotiation of decisions to achieve mutually agreed upon development outcomes. Decision analysis models used for making probabilistic impact projections that consider a multitude of risks and uncertainties is one essential component, and so is the geospatial resilience diagnostic tool. These will build on the targeting and priority setting under present CRPs which was informed by the national level economic surplus modelling. These approaches also allow identifying key knowledge gaps, thus contributing to priority setting. The potential synergies and conflicts of profitability and resilience as simultaneous targets have been demonstrated and provide a basis to further analyse the timing of synergetic innovations and the channels which could facilitate those. The climate change impact analysis cluster will make use of the body of CCAFS and partners work developed in recent years (www.agmip.org) and household and community level baselining datasets. Several scientists in FS1 contributed to the SPIA Report on the effectiveness of crop improvement, and the work on the influence of increasingly diverse income structures on rural development. For impact acceleration, the ‘research in development’ paradigm will be applied enabling co-learning amongst research, development and private sector actors. It is a novel approach for testing options (best bets) on-farm at large scale (to capture heterogeneity in socio-economic and biophysical contexts) together with development partners. It embeds ME&L in the research process and it is presently applied in Dryland Systems and DRYDEV (see Annex 1).

GEOGRAPHY & BENEFICIARIES
FP1 will focus the work in the 17 DCLAS target countries (Burkina Faso, Ethiopia, India, Kenya, Malawi, Mali, Morocco, Mozambique, Nicaragua, Niger, Nigeria, Senegal, Sudan, Tanzania, Uganda, Uzbekistan, Zambia) and also include the target regions (with other FPs, option testing and impact at scale) through the DCLAS regional focus countries. In order to achieve the overall aim of FP1, co-location and integration of the place-based research across FPs is crucial. Different rural household typologies (segment of the population based on resource endowment, gender, age, etc.) and communities will be targeted based on specific challenges and opportunities. Women, young people and disadvantaged groups are at focus all through the work. The diversity in farm household livelihood systems is the focus of the research on drivers and enabling environments (with FP6). The options x context paradigm applied for option testing and scaling explore and
utilize the heterogeneity among farmers (gender, age, resources, etc.) and communities (site characteristics in biophysical and socioeconomic terms) in order to come up with best fit technologies (all FPs).

**PARTNERSHIPS**
Links have been established with PIM, CCAFS, WLE, A4NH and other AFS CRPs dealing with commodities and agri-food systems in dryland areas (e.g. Livestock, FTA, MAIZE, WHEAT). Collaboration is being developed between FP1 and Priority Setting and Scaling FPs of other AFS-CRPs dealing with similar methods and approaches including gender and inclusion. The gender team will participate in the CGIAR gender network. Non-CGIAR Partners will be identified and selected based on identified gaps in competencies and experiences and build on existing well-functioning partnerships in relevant CRPs and W3/bilateral projects. Partners influencing decision making and scaling will be identified and selected through a stakeholder mapping exercise in target countries, for example national and local government, regional organizations (e.g. NEPAD, ECOWAS), farmer and consumer organisations, development actors. Partners for grain legumes include Michigan State and Purdue Universities. The Gender and Agriculture Network is partnering with Pennsylvania State University to support and train gender researchers and postdocs including the DCLAS’ gender team. Further linkages to relevant international and national research institutions and UNWomen will be considered based on excellence, complementarity and anchorage in the target countries and regions.

**CAPACITY DEVELOPMENT**
National and international PhD students and postdocs will be trained and training packages designed with partners to disseminate methods and tools being potential agents of change, e.g. short courses, summer schools, curricula development. Capacity development of DCLAS researchers’ and partners will be carried out in the process of CRP-wide impact focused learning (ME&L). A gender research and integrated training will be designed for DCLAS scientists and partners. It will also host the graduate and postdoc fellows that will help support the typology analysis work, the youth participation agenda as well as the inclusive innovation platforms. Modern technologies, e.g. tablet/mobile phone based interviews, successfully tested in CRPI will be streamlined across DCLAS and along with new deployments trainings for researchers and partners will be organized where necessary. A community of practice is already established and will be further supported and broadened. Several team members have used mass media as an efficient tool to transfer knowledge to a wide audience with initial assessments showing great learning effects. Capacity development is required for these efforts to be expanded under DCLAS with more rigorous assessments.

**FLAGSHIP THEORY OF CHANGE & IMPACT PATHWAY**
FP1 Annex 2 presents FP1s theory of change and impact pathway and how the FP will accelerate and leverage DCLAS impact on the SLOs, IDOs and sub-IDOs. CoA1.1 Foresight, priority setting & learning, to start, will spearhead farmer and other stakeholder engagement processes; foresight and trend analysis; scenario modelling; and gender analysis to inform the research priorities of DCLAS’ other FPs. This will be augmented by work carried out under CoA1.2 Value chains, demand & constraints and CoA1.3 Climate change analysis. Linkages will further be made to CoA1.5 Drivers of adoption and enabling environments so that DCLAS’ research efforts (across FPs) are informed by the realities of smallholder adoption processes. In short, FP1 will help shape DCLAS’ research agenda, so that it is (and remains) relevant, outcome and gender focused, and demand driven. Much of this research agenda will involve in-depth scientific investigation (Discovery), with the ultimate aim of developing innovations for enhancing sustainable intensification and resilience in dryland mixed agriculture (Option Development). For instance, CoA1.1’s foresight, stakeholder consultations, and decision and economic analysis work will help identify demand and ‘good bets’, i.e. options most likely to bring about high impact returns (FP6, 7). In addition, CoA1.4 Empowering women and young people through inclusive innovation systems and CoA1.6 Monitoring, impact assessment and scaling, together with the other CoAs, will support innovation piloting across FPs. A key aim will be to ensure that the demands of various smallholder farmer typologies are met, while simultaneously enhancing the resilience and sustainability of their production systems. Work will also be undertaken with development partners (CoA1.1) and through inclusive innovation systems (CoA1.4) to scale up and test (CoA1.6) the performance of the initially devised
options (from other FPs; FTA, Livestock, etc.) at a larger scale and across a wider range of conditions (Testing@Scale). The resulting learning will be fed back into the option development process across FPs, followed by iterative cycles of refinement and improvement. CoA1.2 and CoA1.3 will specifically generate insights on value chain and climate change adaptation options (link to FP2,3; CCAFS) that are well matched to the heterogeneous conditions of mixed dryland systems (FP5,6,7). Finally, CoA1.5 will interrogate the factors that drive adoption and diffusion of innovations across contexts and socioeconomic groups, with due emphasis on gender and youth. CoA1.6 will further engage with partners to promote the resulting learning about what works, where, for whom, how, and at what cost among development agencies and relevant decision-makers, the second tier of the scaling process (Impact@Scale). This will be complemented by policy engagement starting during priority setting (CoA1.1) to build on desired outcomes and create enabling conditions for the scaling to take place all through the research process (discovery, option development & testing to scaling). Innovation adoption will then be monitored and analysed, alongside the impact assessment data, to estimate DCLAS’ overall impact on improving livelihoods in and the environmental conditions of mixed dryland systems.

*CVs of the writing team are included in Annex 15.*
**Assumptions and Risks:**

A1: Buy in by other FPs and partners in the process. Links to PIM;
Risk: Linkages between FPs in DCLAS not functional/ or delays in across DCLAS collaboration
A2: Functional partnerships can be established within DCLAS and with private sector partners.
Risk: Weak demand for DCLAS target commodities
A3: Other FPs will provide relevant options to be tested using models. Links to CCAFS
Risk: Linkages between FPs in DCLAS not functional/ or delays in across DCLAS FPs collaboration
A4: Successful identification of relevant and capable partners to facilitate local work with women and youth groups
A5: Buy in by other FPs in the process
Risk: Weak demand for DCLAS target commodities. Weak partnerships and policy environments
A6: Buy in by other FPs in the process
FP1 Annex 2. RELEVANT PREVIOUS PROJECTS

Ongoing activities have been listed where FP1 scientists have experience and net-works to bring into and enrich DCLAS, to be fully or partly mapped to DCLAS (W3/bilateral) by the participating centers. To build DCLAS research on well-tested and successful partnerships will facilitate a kick-start and form the basis for innovations to reach scale delivering impact towards the SDGs, SLOs and IDOs.

Tropical Legumes II aims to enhance grain legume productivity and production and the incomes of poor farmers in drought-prone areas of Sub-Saharan Africa and South Asia. The project is funded by the Bill & Melinda Gates Foundation and implemented jointly by ICRISAT, CIAT, IITA and national research institutions (NARS) since 2007, with phase III approved for 2015-2018. It demonstrates successful collaboration across institutions as well as disciplines in the area of legume research and has produced outstanding success in supporting smallholder farmers in 9 countries in Sub-Saharan Africa (Mali, Niger, Nigeria, Mozambique, Malawi, Tanzania, Kenya, Ethiopia) and South Asia (India). Tropical Legumes II includes strong components of capacity development and is carried out in partnership with private sector seed companies and NGOs. http://www.icrisat.org/TropicalLegumesII/

HOPE: The Harnessing Opportunities for Productivity Enhancement of Sorghum and Millets in Sub-Saharan Africa and South Asia seeks to help smallholder farmers increase the yields of the two dryland cereal crops sorghum and millet in West Africa (Mali, Burkina Faso, Niger and Nigeria), Eastern Africa (Sudan, Ethiopia, Eritrea, Uganda, Kenya and Tanzania) and India. HOPE is funded by the Bill & Melinda Gates Foundation and implemented by ICRISAT, ICARDA and NARS since 2009. It harnesses the synergies between institutions and countries and successfully demonstrates how the sum can be bigger than its parts. The project has strong components of capacity development. http://hope.icrisat.org/

DRYDEV: The Drylands Development Programme (2013-2018) is funded by the Ministry of Foreign Affairs (MoFA) of the Netherlands via the General Directorate of International Cooperation (DGIS), with a substantial contribution from World Vision Australia (WVA). ICRAF is the overall implementing agency working in partnership with national actors and development organizations. DRYDEV is designed to provide relevant, contextually appropriate support to over 227,000 smallholder farmers in selected dryland areas of Burkina Faso, Mali, Niger, Ethiopia, and Kenya. It is seeking to meaningfully contribute to the realization of a vision where households residing in such areas have transitioned from subsistence farming and emergency aid to sustainable rural development. This is to be achieved by increasing food and water security, enhancing market access, and strengthening the local economy for different categories of farmers. Embedding research in development has proven to be a way forward; approaches for monitoring, evaluation, learning and scaling will be brought into DCLAS. http://www.worldagroforestry.org/content/drylands-development-programme

Africa RISING: The Africa Research in Sustainable Intensification for the Next Generation program is supported by USAID and comprises three projects led by IITA, ILRI and IFPRI and implemented with a number of partners (CGIAR, NARS, NGOs, etc.). Africa RISING seeks to provide pathways out of hunger and poverty for smallholder families through sustainably intensified farming systems that sufficiently improve food, nutrition, and income security, particularly for women and children, and conserve or enhance the natural resource base. The research objectives are to identify and evaluate demand-driven options for sustainable intensification and to evaluate, document and share experiences with approaches for delivering and integrating innovation for sustainable intensification. Development objectives include creating opportunities for smallholder farm households within Africa RISING action sites (Ghana, Mali, Tanzania, Malawi, Zambia, Ethiopia) to move out of poverty and improve their nutritional status and to facilitate partner-led wider dissemination of integrated innovations for sustainable intensification. http://africa-rising.net/

Treesilience: The role of trees in enhancing the resilience of livelihoods and economies in the drylands of Eastern Africa was the focus of this UK funded project1. It has contributed to the national and regional efforts to support actions to increase household assets needed to reduce vulnerabilities of affected communities. 2De Leeuw J, Njenga M, Wagner B, Iiyama M. (Eds.) 2014. Treessilience: An assessment of the resilience provided by trees in the drylands of Eastern Africa. Nairobi, Kenya. ICRAF 166 pp. http://www.worldagroforestry.org/downloads/Publications/PDFS/817611.pdf

DCLAS PRE-PROPOSAL 24
# FP1 Annex 3. FP1 Linkages to other FPs

<table>
<thead>
<tr>
<th>Cluster of Activities</th>
<th>Collaborating FP</th>
<th>FP1 role</th>
<th>Collaborating FP role</th>
<th>Outputs; Added value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1 Foresight, priority setting and learning</td>
<td>All FPs</td>
<td>CRP1 will conduct inclusive, demand-driven research that is in line with farmers’ needs, local and national priorities, the SDGs, the CGIAR’s SLOs, etc. By working closely with other FPs, FP1-CoA1.1 will contribute to this by conducting foresight studies and facilitating stakeholder (e.g. farmers, policy makers, and development agencies) awareness and engagement processes to elucidate perspectives and desired outcomes, as well as context-specific assets, constraints and opportunities that influence decision making.</td>
<td>FP1 and other FPs are working closely together in priority setting (see box to the left, FP1 role). The results will be jointly used to guide the CRP1’ research agenda.</td>
<td>The results will be jointly used across FPs to guide CRP1’ research agenda. CoA1.1 will also contribute to the option development process by building on existing evidence and modelling of the likely outcomes of particular innovations and approaches.</td>
</tr>
<tr>
<td>1.2 Value chains, demand and constraints</td>
<td>All FPs, in particular links to FPs 2, 3, 7</td>
<td>FP1-CoA 1.2 will identify value chains that have strong potential to benefit dryland farming households while ensuring social inclusion. To quantify consumer demand across different regions a synthesis of studies will be used to identify the most promising chains which are or could be accessible to dryland farmers and identify the key demand</td>
<td>FP1 and other FPs are working closely together in identifying value chains that have potential to benefit dryland poor households and consumers ensuring social inclusion (see box to the left, FP1 role). The results will guide the CRP1’ research agenda across FPs.</td>
<td>Enhanced market participation to reduce poverty. Strong marketing prospects for the product, scaling potential, representation of the various social groups and the number of poor people involved in the chain.</td>
</tr>
<tr>
<td>1.3 Climate change impact analysis and strategies for adaptation</td>
<td>All FPs, in particular FPs 2, 3, 5, 6</td>
<td>FP1-CoA1.3 The impact of climate change and variability and potential adaptation options for drylands need to be better understood when developing new technologies in</td>
<td>Analysis of climate change and adaptation options will be carried out in collaboration with other FPs in order to guide the development of adaptive</td>
<td>Ex-ante impact assessment of climate change and variability in areas dominated by mixed dryland systems</td>
</tr>
</tbody>
</table>
order to reduce risks and shocks, improve food and nutrition security and reduce poverty in the dryland mixed systems

| 1.4 Empowering women and youth through inclusive innovation systems and learning | All FPs, in particular FPs 4, 6, 7 | FP1-CoA1.4 will develop adaptive models/agendas for ‘inclusive innovation systems’ as learning and innovation platforms for women and youth in agriculture to be developed and implemented together with other FPs and national and development partners. | Inclusive innovation systems cuts across and links to all other FPs. Also link to the gender CRP cross-cutting work | Create opportunities for women, young people and marginalized groups in drylands communities by emphasizing equitable access to resources, information and power in the livelihood systems |
| 1.5 Drivers of adoption and mechanisms that facilitate scaling | All FPs | FP1-CoA1.5 will develop knowledge on drivers of adoption and mechanisms that facilitate scaling in the dryland mixed systems and target areas | Analysis of information requirements, dissemination channels and enabling policies will provide feedback to other FPs and identify development partners that have the most appropriate skill set and institutional arrangements to facilitate dissemination and adoption at scale in the target locations and beyond. | Improved match between end-user demand, research supply and understanding and facilitating enabling environments will contribute to outcomes and impact, e.g. in terms of income generation. |
| 1.6 Monitoring adoption, impact assessment and scaling | All FPs | FP1-CoA1.6 will support innovation development, assessment and scaling processes | FP1 is working closely together with all other FPs from the CRP planning phase and throughout | The research-in-development and impact assessments will generate important evidence |
| across CRP1 FPs, facilitate CRP-wide impact focused learning (ME&L), and generate evidence of CRP1’s impacts and its contribution to the IDOs and SLOs | the CRP lifespan. FP1-CoA1.6 will facilitate the option development process through designing and carrying out, in close collaboration with other FPs, efficacy studies of the impacts of promising innovations on various outcomes, such as crop yields, household income, food and nutrition security, and empowerment (internal validity). To address the external validity challenge and as one key component of the scaling process, the performance of devised options from other FPs will be tested at larger scales and across heterogeneous conditions. | relevant to the scaling agenda which will take place with partners to influence key decision-makers to promote options developed and tested under other FPs in CRP1, and create policy and institutional conditions conducive for facilitating uptake. The final focus will be to estimate CRP1’s overall impact by both critically assessing how it has influenced wider policy and practice and monitoring the wider uptake of proven options and extrapolating the corresponding impact. |
FLAGSHIP 2: PRE-BREEDING & TRAIT DISCOVERY

RATIONALE
The four cereal and eight legume crops that anchor the Phase II CGIAR Research Program on Dryland Cereals and Legumes Agri-food Systems (DCLAS) together contribute to a total harvested area of 147.68 million hectares in the core and satellite target countries of the program, accounting to a dry-grain production of 141.740 million tonnes (FAOSTAT, 2013). The program aims to improve inclusive income, food and nutrition security, and environmentally sustainable farming practices, in small-holder agricultural systems that involve legumes globally, and dryland cereals in Africa and Asia, building on past successes and lessons:

- Most of our crops now have genome sequences
- Cross-crop comparisons revealed common drought resistance mechanisms
- Heat tolerance had received little prior attention but is well on its way toward mainstreming
- Interspecific crosses have proven productive and offer new horizons for further improvement
- Markers for many disease resistance genes are available and ready to deploy
- Partners are engaged and networks are in place

DCLAS Flagship 2 on Pre-Breeding and Trait Discovery focuses on (1) understanding the genetic, biochemical and physiological bases of crop- and region-specific target traits, (2) the deployment of this knowledge towards the development of tools and technologies for germplasm screening and selection, and (3) the utilization of these tools and technologies for the rapid screening and selection of promising varieties and hybrids that meet the requirements for local adaptation, end-use orientation, and tolerance or resistance to prevailing abiotic and biotic stresses. The primary crop species addressed by the Flagship are barley, chickpea, common bean, cowpea, faba bean, finger millet, groundnut, lentil, pearl millet, pigeonpea, sorghum and soybean, and the target countries are prioritized based on crop acreage, poverty levels and malnutrition. Country-wise trait targets will be informed by prevailing needs of the subsistence-farming population in the rural areas as well as by end-use preferences of existing or emerging local, regional, or global markets. A summary of crop-country-trait combinations under current research is presented in Annex 1. Our focus will be on those crop-trait combinations that will lead to significant impacts in the chosen target regions both in the short term and in the medium/longer term.

Flagship 2 constitutes the first half of the product delivery pipeline for varieties and hybrids within DCLAS, working in close association with Flagship 3 (Variety and Hybrid Development) for fluid continuity to product delivery. Guided by the successes and challenges of Phase I of the component programs of DCLAS, the innovative introductions in Phase II for Flagships 2 and 3 are:

1. Organization of the Clusters of Activities of the two flagships along four different stages of a variety/hybrid development pipeline, including Stage A (concept or idea development), Stage B (proof of concept and variety/hybrid selection), Stage C (wide-area testing of selected varieties/hybrids), and Stage D (final selection, pre-release characterization and release). This pipeline also envisions and streamlines data-driven annual gateway decisions for germplasm advancement from one Stage to the next, with accountability of delivery incorporated into the Performance Matrix at all levels.

2. Emphasis on widespread implementation of genomics-assisted breeding, enhancing traditional breeding, leveraging the Breeding Evaluation Tools, and the recently approved Global and Open Breeding Information Initiative (GOBII) supported by BMGF and the Consortium Office.

3. Specific to Flagship 2, a Cluster of Activities fully devoted to enabling technologies and platforms that address (a) (molecular) genetic, biochemical or physiological methodologies for high-throughput trait screening in the laboratory, controlled environment and the field, (b) molecular and tissue-culture tools for accelerated genetic gain including a functional genomics platform to establish gene-to-phenotype relationships, and (c) crop simulation tools to guide the choice of traits that should be pursued in the screenings and breeding applications.
Research for development for productivity gains in the twelve nutrient-rich and/or climate-resilient target crops directly addresses the grand challenges of (1) competition for land, (2) climate change, and (3) nutrition and diet diversity. Continuing utilization of novel genetic diversity, including interspecific or transgenic variability, for yield enhancement and yield stability are essential components of our crop improvement research, so this Flagship also addresses a fourth grand challenge: diminishing genetic resources. Finally, development of crop cultivars, especially legumes, with increased below-ground root mass, sometimes at the expense of harvest index, can contribute to increased organic matter and the reclamation of degraded land; carbon sequestration and nitrogen fixation are additional targets.

Within the overarching agri-food systems context of DCLAS, flagships 2 and 3 are themselves organized along a variety/hybrid development pipeline, in a way that is similar to the organization of delivery pipelines in seed companies, but with specific acknowledgement and incorporation of line-breeding (as opposed to trait breeding) processes where required. Research on crop improvement in the DCLAS flagships FP2 and FP3 is organized along four stages from A to D, on a trait (yield, stress tolerance, quality etc.) basis, to address and track delivery of region-specific trait needs for the different crops. Stage A constitutes the development of concepts and ideas together with FP 1, and includes activities such as crop simulation and modelling, the search of literature and patents for novel methodologies, and collaboration with the Genebanks CRP. Stage B establishes proof of concept through laboratory, controlled-environment and field research, and proves the superior performance of varieties and hybrids. It includes pre-breeding activities such as germplasm development, expanding the germplasm pool through wide outcrosses, multi-parental populations etc., backcrossing and management of allele frequencies, trait phenotyping and deconvolution of the genetics associated with a given phenotype. Field performance of the superior varieties and hybrids is established through two seasons of testing in limited testing locations, before they are advanced to Stage C. In addition to the initial establishment of superior performance of genetic material, Stage B also includes the development of enabling technologies and platforms that are critical to the establishment of proof of concept.

The Clusters of Activities for the crop improvement flagships, FP2 and FP3, are trait-specific (and not crop-specific), and as such address the relevant target crops associated with a particular trait of importance within a single Cluster of Activities, though product delivery adhere to a crop basis. To some extent, the trait-specific organization of CoAs facilitate cross-utilization of fundamental expertise (entomology, pathology, genomics, phenotyping, bioinformatics), and the application of emerging information across crops wherever similarities exist for gene-to-phenotype associations. The establishment of common technology platforms that incorporate or utilize crop-specific platform ingredients, for example, molecular markers, contributes to economies of scale. Thus, Flagship 2, Pre-Breeding and Trait Discovery, includes six Clusters of Activities, namely, (1) Pre-Breeding, (2) Trait Discovery - Agronomic Traits, (3) Trait Discovery – Nutrition and Quality Traits, (4) Trait Discovery - Disease Resistance, (5) Trait Discovery – Resistance to Insects and Weeds, and (6) Enabling Technologies.

**CLUSTERS OF ACTIVITIES (CoA)**

**CoA 2.1 PRE-BREEDING:** Relative to major crops like maize, significant amounts of natural diversity remain as yet untapped in DCLAS target crops largely due to the reticence of breeders to resort to unimproved germplasm in their breeding programs, with their attendant issues of undesirable traits and possibly negative genetic linkages. The tendency to emphasize short term outputs in projects similarly argues against committing to activities that are necessarily long term. This is therefore an activity that an international program like the CRP should assume, in the context of producing International Public Goods in the form of broader genetic diversity that is both accessible and more readily useful to conventional breeders. This CoA focuses on:
1. Crop modelling coupled to a network of representative testing locations to identify critical stress responses, to test predictions of most promising genetic trait / agronomic management alteration to increase productivity, including yield gap analysis, in target regions and crops.

2. Deployment of genes/alleles identified in CoAs 2.2, 2.3, 2.4 and 2.5 in genetic backgrounds with a general degree of adaptation to environments where mainstream breeding programs operate, such that poor adaptation does not seriously confuse selection. This includes the development of a range of bi- and multi-parent genetic populations, precise trait screening and functional genomics platforms, together with the use of locally-adapted and farmer-preferred traditional varieties, with specific focus on traits of relevance and importance to women subsistence farmers.

3. A wider exploration of interspecific variability as used to date in barley, chickpea, common bean, lentil and pigeonpea, and novel approaches such as the reconstitution of the *Arachis hypogea* genome from its putative wild ancestors.

4. The identification and utilization of molecular information underlying resilience to extreme weather conditions, and to existing and emerging insect pests, weeds and diseases.

5. Enhanced methods of introgression, for example, by the identification of bridging genotypes.

6. The selection and utilization of traits such as modified plant architecture for increased density of planting, increased harvest index, and potential exploitation of mechanization options, especially in communities transitioning from subsistence to market-oriented agriculture.

7. Tracking of introgression through molecular markers

8. Exploiting high-density genotyping, breeding informatics, precise trait screening and functional genomics platforms.

The outputs from this CoA include novel diversity, parental genotypes, molecular tools for gene discovery and allele mining, and markers for critical traits.

**CoA 2.2 TRAIT DISCOVERY – AGRONOMIC TRAITS:** Agronomic traits, within the context of this Flagship, includes complex, multi-loci, quantitative traits such as yield enhancement, nutrient-use efficiency, nitrogen fixation and tolerance to abiotic stresses such as drought, heat, cold and salt.

**Yield enhancement** will remain an important trait of focus for all target crops and geographies of the program as long as the untapped genetic potential of these crops offer opportunities for significant yield gains far beyond that realizable in the major crops at the present time. Our emphasis during Phase II is on the rapid development, testing and release of high-yielding varieties or hybrids by moving beyond traditional breeding and utilizing crop-specific advanced methods and technologies for:

1. accelerated genetic gain opportunities through the identification of molecular markers for large-scale deployment in FP 3,

2. reduced breeding time through the establishment and use of locations for shuttle-breeding and off-season nurseries,

3. transition from open-pollinated varieties to hybrids, where the floral biology of the crop allows and proof of concept has been established, as in the case of pearl millet, pigeon pea and sorghum, and

4. the exploitation of an early maturity trait in relevant crops (eg., short duration chickpea in rice fallows) to increase whole-farm production by facilitating an additional crop during the year

Several large bilateral projects that are either ongoing, newly approved or in the process of preparation will contribute to activities and outputs relevant to the above for yield enhancement, as well as to improvement of other traits. These include Tropical Legumes (TL) III, the Global and Open Breeding Information Initiative (GOBII) and Harnessing Opportunities for Productivity Enhancements in sorghum and millets (HOPE) II. The recently approved GOBII project facilitates the creation of large genomic databases and the storage of high-density
genotype data for linkage to pedigree information to enable seamless queries for precision in breeding decisions pertinent to chickpea and sorghum, in addition to three other crops in other agri-food system programs.

**Nutrient-Use Efficiency** research within DCLAS during 2017-2022 will include:

1. The GCP Comparative Genomics Challenge Initiative led by EMBRAPA and Cornell University on Al tolerance and P uptake has moved forward from the cloning and characterization of the major sorghum Al tolerance gene, *SbMATE*, and the identification of gene-specific markers for candidate sorghum P efficiency gene, *PSTOL1* (Magalhaes et al, 2007). The Magalhaes and Kochian labs have increased their understanding of the transcriptional mechanisms that regulate *SbMATE* expression and have identified sources of Al tolerance that are more resilient to genetic background effects (Melo et al., 2013). Several hundred lines derived from random-mating populations and genotyped using GBS and gene specific markers are now ready for further research.

2. Identification of root traits conducive to nutrient uptake and fertilizer use efficiency giving continuity to work in Product Line 1 of the GL CRP where superior genotypes were identified in field trials.

3. Quantification of the effects of abiotic stress on N fixation in common bean were carried out in phase 1, and genotypes with relatively better SNF under stress were identified. Similarly, climbing common bean genotypes with high potential were identified. The mechanisms behind such traits are not known but merit study. We propose further evaluation of the genetic potential of legume germplasm for the capacity to fix N symbiotically, especially under conditions of water limitation or low soil P availability. This would be linked to FS5 and could involve activities on optimizing the productivity of cereals/legumes rotations/associations.

4. Evaluation of rhizobial strains (through N2Africa) for improved nitrogen fixation coupled to the corresponding plant genetics in the target legume crops, and the exploration of other plant-growth-promoting organisms including vesicular-arbuscular mycorrhizae and endophytes for improved growth of selected target crop species in selected geographies where such interventions are viable

**Abiotic-stress tolerance or resistance** is another agronomic trait that this CoA will address, with predominant focus on drought and heat during 2017-2022. While the molecular mechanisms underlying drought, freezing and salt tolerance overlap to some extent due to the common physiological responses to dehydration, the underlying molecular mechanisms of drought, heat and cold are distinct. Several biochemical pathways, regulatory genes, and gene families have been identified for proven or potential effect on tolerance to these abiotic stresses (Kumar and Wigge, 2010; Sivasankar et al., 2012a). In addition, micro-RNAs and alternative splicing mechanisms play a major role especially in the adaptation to abiotic stresses. The physiological mechanisms of drought tolerance in relation to water economy are also addressable with high throughput phenotyping and well characterized mapping populations (eg Vadez et al., 2015). We plan to address the following activities towards the testing, identification and use of molecular markers for drought and/or heat tolerance for six selected crops of the twelve, namely, barley, chick pea, common bean, cowpea, pearl millet and sorghum:

1. Systematic collection of homologous sequence information of those genes, splice variants and micro-RNAs reported to have a functional effect on tolerance or resistance to drought and heat,

2. Assess the available populations with rigorous phenotyping information for drought and heat tolerance, and generate the required material and information where gaps exist

3. Evaluate genetic associations for tolerance/resistance to drought and heat using re-sequence information and phenotypic data, and

4. Identify markers for the trait and deploy for high-throughput use

Identified markers will be utilized for the screening and selection of varieties or hybrids with improved tolerance or resistance to drought and heat. We will leverage existing collaborations for heat tolerance. We will build on the in-house-generated information on genotype-based differential transpiration response to vapor-pressure deficit under drought stress and non-stress conditions that contributes to sustained growth and yield (Aparna et
al., 2015; Vadez et al., 2015). Finally, specific molecular information confirmed for association with drought or heat tolerance in the highly resilient crops, chickpea, pearl millet and sorghum, will be extended through genome editing technologies, at least to the level of functional validation, to crops less resilient to drought and heat stress, including maize and rice (where we will collaborate with the CRPs MAIZE and RAFS/GRiSP).

CoA 2.3 TRAIT DISCOVERY – QUALITY TRAITS: Quality traits of focus in breeding during 2017-2022 are:
1. Fodder quality for all of the target crops, in collaboration with the CRP on Livestock, through the concept of “Full-purpose crops”
2. Food safety for groundnut through aflatoxin resistance in collaboration with the USAID Feed the Future Innovation Lab for Collaborative Research on Peanut Productivity and Mycotoxin Control, at the University of Georgia, USA, and with the CRP on A4NH
3. Macronutrient quantity and quality (starch type, oil content and composition, protein content)
4. Improved grain micronutrient concentration (iron, zinc and/or calcium), in collaboration with A4NH. Research on enhanced productivity in DCLAS complements research on improved nutrition in A4NH.
5. Reduced anti-nutrition factors such as phytate in sorghum, and vicine and convicine in faba bean, again in collaboration with A4NH, and
6. Reduced rancidity of pearl millet flour
While exploration for molecular markers for all of these quality traits is already in progress, they will be investigated functionally using targeted analysis of specific pathways and regulatory genes; for example, forage digestibility is heavily influenced by the expression of the genes of the lignin biosynthetic pathway and the associated transcription factors, and by the differential accumulation of syringyl and guaiacyl lignin fractions (Sivasankar et al., 2012b). In addition to marker development for breeding, we will expand grain- and fodder-quality screening facilities, such as NIS and the X-Ray Fluorescence analyser purchased with support from CRP Dryland Cereals in its first phase and installed at IER, Sotuba, Mali, which currently serves as a central point for fodder-quality analysis in West and Central Africa. We will also explore the possibilities of developing and using field-based Near-Infrared Spectroscopy for high-throughput fodder-quality analysis and extend its application to grain quality.

CoA 2.4: TRAIT DISCOVERY – DISEASE RESISTANCE: This CoA will develop, screen and select varieties and hybrids with resistance to the predominant diseases of the target crops, as listed in Annex 1. The disease traits of current research as listed in Annex 1 will be prioritized for research investments based on the severity of yield loss, extent of disease prevalence, and local/regional demands. Soil-borne diseases are a problem common to most of the legumes offering possible synergy as is blast in the cereals. Established laboratories and locations that are currently being used for laboratory, controlled-environment, or field-based screening of germplasm for disease-resistance will continue to be supported. Further, Genome-Wide Association Studies (GWAS) will be conducted, or strengthened to identify loci conferring resistance which once confirmed can provide markers for breeding for resistance.

CoA 2.5: TRAIT DISCOVERY – RESISTANCE TO INSECTS AND WEEDS: Insect pests of the target crops include the aphid, shoot fly, stem-borer and midge. The pod-borers, Helicoverpa armigera and Maruca vitrata cause losses in chickpea, cowpea and pigeon pea estimated at over US$ 1 billion annually despite insecticide applications costing more than $500 million (Sharma, 2005). Only low levels of resistance to pod borers exist in cultivated chickpea, cowpea and pigeon pea, so screening of and introgression from wild relatives will be undertaken and complemented by and transgenic approaches. Breeding for pest resistance will be combined with simple, integrated pest management practices in collaboration with FP5, Integrated Land, Water and Crop Management. Yield losses from parasitic (Striga, Orobanche) and non-parasitic weeds are severe in both legumes and cereals.
Breeding for resistance to *Striga* has been successful for sorghum and cowpea, while sources of resistance to *Orobanche* have been identified for lentil and faba bean. These efforts will continue in Phase II. For countries and regions where high-input agriculture is practiced, we will continue to explore the combination of herbicides and herbicide-tolerant crop varieties through mutation breeding, as well as transgenic technologies for both insect and herbicide tolerance, using the efficient transformation-protocols available for some of our target crops amongst partners, both CG and non-CG, as guided by the ISPC’s strategy study on biotechnology (ISPC 2014).

**CoA 2.6 ENABLING TECHNOLOGIES:** Enabling technologies forming Stage B include (1) structural-genomic technologies/platforms including genome sequencing and high-throughput marker platforms, (2) functional-genomic technologies/platforms including high-throughput gene-functionality analysis, generation and utilization of forward- and reverse-screening populations such as TILLING or activation-tagged populations, (3) biochemical platforms for nutritional and food/feed/fodder quality analysis at high throughput, (4) phenomic technologies for controlled-environment high-throughput screens based on key physiological parameters, (5) informatic tools and databases to support FP3 and (6) hybrid-seed production technologies that constitute the basis for accelerated genetic gain, such as the induction of haploidy and the creation and utilization of genetic male sterility.

**2.6.1. Structural-genomic technologies/platforms:** This effort will establish or streamline the large-scale identification of molecular markers for reliable high-throughput screening and rapid selection of improved breeding material for the traits of focus. Marker-assisted breeding has not fully pervaded crop-improvement efforts in our target crop species. Of the program’s twelve cereal and legume crops, only the 13Gb faba bean genome remains without a draft genome sequence. Large-scale resequencing has been or is in the process of being completed for hundreds of varieties, lines, parental genotypes and wild accessions of several of these crops. Successful utilization of sequence information for breeding decisions requires a systematic approach, starting from the careful identification or development of populations, resequencing accompanied with precision phenotyping, disciplined and organized data warehousing, and rigorous statistical analysis to establish definitive gene-to-phenotype associations as facilitated by the BMGF- and CO-supported GOBI project on sorghum and chickpea at ICRISAT. The Lead Center is discussing analytical platforms for cost-efficient high throughput, such as the combination of the Douglas Array Tape lab-automation system and the LGC KASP genotyping assays and reagents, and is in collaborative discussions with the DuPont Pioneer Multi-Crop Research Center at Hyderabad. The successful utilization of sequencing or genotyping information requires parallel information on precision phenotyping, to be addressed in close collaboration with Activity 4 under CoA 2.6 of FP2.

**2.6.2. Functional-genomic technologies/platforms:** During 2017-2022, we will explore the potential of a two-part functional genomic platform in a pilot mode, with one part based on medium-throughput transformation and the second based on mutation breeding. The ultimate objective of this functional genomic platform is to enable the development or confirmation of functional gene-to-phenotype association information through medium-throughput model-system or target-crop transformation, and/or through reverse or forward breeding with mutant or activation-tagged populations. Functional analysis of targeted genes with potential links to traits of interest, ideally simple traits, can be accomplished through a transformation platform based on genome editing through CRISPR/Cas9 to generate events for trait screening. Activity 2.6.2 will also include mutation breeding through the development and use of systematic mutant population(s) such as TILLING populations. Discussions already in progress with Dr Brad Till of IAEA in Vienna foresee the development of at least one TILLING population for one legume and one cereal crop. As with 2.6.1, the success of this platform also depends on large-scale precision phenotyping with sufficient replicates to ensure confidence in decision-making.

**2.6.3. Biochemical platform for nutritional quality analysis:** We plan to strengthen or revive two nutritional quality analyses labs, one in IITA and one in ICRISAT Zimbabwe. This will allow the screening of grain and stover of the target crops for nutritional quality for food, or for digestibility of feed and fodder, in the two main regions of the continent, WCA and ESA. The food science and nutrition expertise available at IITA will be leveraged to
develop and calibrate quality analyses that can be scaled for throughput and efficiency. A nutrition lab established in the eighties in Bulawayo, Zimbabwe, with USAID support enables it to serve the quality analyses needs of ESA with some upgrading.

2.6.4. **High-throughput phenotyping platform:** This is central to the success of both 2.6.1 and 2.6.2 and will function in close collaboration with these. It involves the development and deployment of medium-to-high throughput screening methodologies in the lab or controlled environment for reliable selection and advancement of germplasm. During the initial part of Phase II, we will leverage the capacities of the existing screening facilities for abiotic stress, primarily drought, and the existing biotic-stress screening facilities (insectaries, leaf feeding assays). Alongside we will evaluate gaps in trait-screening methodologies and instrumentation and establish or assemble these as necessary, thus developing a centralized infrastructure to serve a variety of traits.

2.6.5. **Hybrid seed production technologies:** During 2017-2022, our efforts on this front will focus on (1) the induction of haploidy for accelerated development of hybrids in sorghum and pearl millet through the identification and modification of the kinetochore protein, CENH3, and (2) exploration of the use of genetic male sterility, and associated technologies, where possible, for hybrid seed production.

**FLAGSHIP THEORY OF CHANGE & IMPACT PATHWAY**

Economic studies indicate that there is much unsatisfied demand for legumes, and increased production would find ready markets and would lead to greater aggregate. This would translate into enhanced nutrition due to greater ingestion of micronutrients and a superior amino acid balance with cereals. In dryland environments, sources of carbon are limited and competition exists between soil improvement and animal nutrition. An increase in biomass production of cereals would benefit both purposes. The ToC and IP for FP2, along with the assumptions, and unintended consequences are given in FP2_Annex 1.

**Lessons learned**

- Results with interspecific crosses give us confidence that broad allelic variation exists in the species under consideration. The regeneration of the interspecific hybrid that resulted in cultivated groundnuts (*Arachis hypogea*) opens the spectrum of accessing totally new genetic variability. *Phaseolus* species that can be crossed with common bean span ecologies from arid deserts to humid montane environments. Sister species of *Cicer* and of *Cajanus* offer resistance to insect pests that have avoided genetic control for years.

- Utilization of sources of abiotic tolerances specifically alleles contributing drought tolerance in barley from *Hordeum spontaneum* to *H. vulgare* has contributed drought tolerance of barley germplasm. Currently, ICARDA's barley germplasm are introgressed with these alleles contributing barley germplasm adapted to wide range of climatic and agroecological niches.

- In sorghum, resistance QTLs for *Striga* resistance in wild accessions have been introduced into 3 highly susceptible cultivars. Four lines with improved *Striga* resistance were released in Sudan.

- The private-public partnership for malt barley R4D has the potential to increase the income of small holder farmers with premium pricing and assured procurement system.

- The essence of an impact pathway is the relations among suppliers and demanders of technology at each step of the pathway. Relations based on trust are cultivated, not dictated or hypothesized.

- The core breeding program must operate in the “Global integrating systems” to assure effective and appropriate orientation and efficiency by providing varieties with location-based adaptation.

**PARTNERSHIPS:**

Connections with other CRPs: CCAFS (on site communication facilitated by beans), A4NH, through HarvestPlus (pearl millet, sorghum, beans, lentils, cowpeas) and aflatoxin research in groundnut, PIM on integrated systems models & value chain, WLSE (farming systems, watersheds, and in end-of-season residual moisture), Livestock CRP (barley, sorghum, pearl millet, lentil and stover quality), Wheat and Maize CRPs (barley, lentil, faba bean, chickpea, beans, cowpeas and soybeans), GRiSP (lentil, chickpea), RTB (bean, cowpea), Genebanks, IBP (all crops)
Some other crops share similar abiotic constraints, and similar screening approaches and/or sites could be used, possibly facilitated by the legumes species as an entry point to other cereal-based systems.

**Non-CGIAR Partners:** ARI-Egypt, ARI-Sudan, BARI, CIRAD, Cornell Univ, DARI (Iran), EIAR, EMBRAPA, FAO, GDAR Turkey, GRDC Australia, IAEA, IAR (Nigeria), ICAR (India), IER, INRAN, ISRA/CERAAS, INRA (Morocco), IIAM (Mozambique), KALRO (Kenya), DRD (Tanzania), NARO (Uganda), NARC-Nepal, SMIL, UC Davis, UGA (University of Georgia), UC Riverside, University of Saskatoon, University of Queensland, USDA, and WSU-Pullman. A list of existing partners is presented as annex to Part I.

**Strategy to select partners:** These are of two types: Upstream partners who can deliver knowledge and expertise for the deployment of genetic resources in breeding (eg UC Davis or CIRAD) and those that can assist in development and delivery of outputs to useful outcomes (NARS such as BARI, INRA or EIAR).

**CAPACITY BUILDING:** See the CRP-wide description of capacity building.

**GENDER:**
A gender lens is critical at the initiation of a trait development/breeding pipeline, to assure that traits that are of interest to women, or that represent opportunities for youth, are included from the start. In many environments and cultures, women are the principle producers of these crops. Women often have a narrow resource base with little capital to invest in inputs to ameliorate climatic or edaphic stress, such that technologies that favor resilience –including resilient cultivars with drought tolerance or nutrient efficiency –have a special relevance for women. On the consumption side, these crops also have special significance for women given their high nutritional value, especially their iron concentration, since women have greater needs for dietary iron than men. As care givers, women also channel nutrition to children. Finger millet, for example, is used in a favorite porridge for young children, and legumes are being used as components of prepared products for under-5’s. Maintaining the nutritional role of these crops in the hands of women implies addressing their properties of product quality as well as their agronomic potential.

**LIST OF FIVE RELATED PROJECTS**
- Tropical Legumes (I, II & III) [http://www.icrisat.org/TropicalLegumesII/](http://www.icrisat.org/TropicalLegumesII/)

*CVs of the writing team are presented in Annex 15.*
Assumptions

- This flagship is predicated on the assumption (sustained by recent experience) of adequate genetic diversity and that partner institutional stability will permit on-going collaboration.
- We expect that interaction with system elements of this and other CRPs will facilitate the necessary linkages to avail products to practitioners in the formal and informal seed sector, in the nutrition sector; and to marketers.

Unintended consequences

- Breeding programs deal with target areas over long periods of time, as part of the testing and release procedures are in place in most countries. Thus the system in place is designed to avoid “surprises” at the end of the product delivery process.
- A possible trade-off between markets and household nutrition, as farmers are tempted to sell more nutritious, high-value products and consume cheaper (carbohydrate rich) foods at home. This will be monitored with colleagues in other flagsips.
- A major issue for the development of commercially viable varieties of our crops is that these may change from home-produced foods of high nutritional value to commodities with a cash rather than nutritional return. This also has potential negative consequences for gender-sensitive changes in the distribution of benefits, particularly considering folate, iron and protein in the diet.
## DCLAS Target Countries

<table>
<thead>
<tr>
<th>Zone</th>
<th>Country</th>
<th>Species</th>
<th>Abiotic Stress</th>
<th>Quality</th>
<th>Biotic Stress</th>
</tr>
</thead>
<tbody>
<tr>
<td>CWANA</td>
<td>Morocco</td>
<td>Lintil</td>
<td>Y</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>CWANA</td>
<td>Morocco</td>
<td>Barley</td>
<td>Y</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>CWANA</td>
<td>Morocco</td>
<td>Faba bean</td>
<td>V</td>
<td>V</td>
<td>Y</td>
</tr>
<tr>
<td>CWANA</td>
<td>Morocco</td>
<td>Chickpea</td>
<td>V</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>ESA</td>
<td>Ethiopia</td>
<td>Chickpea</td>
<td>Y</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>ESA</td>
<td>Ethiopia</td>
<td>Common bean</td>
<td>V</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>ESA</td>
<td>Ethiopia</td>
<td>Faba bean</td>
<td>V</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>ESA</td>
<td>Ethiopia</td>
<td>Finger Millet</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>ESA</td>
<td>Malawi</td>
<td>Chickpea</td>
<td>V</td>
<td>V</td>
<td>Y</td>
</tr>
<tr>
<td>ESA</td>
<td>Malawi</td>
<td>Common bean</td>
<td>V</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>ESA</td>
<td>Malawi</td>
<td>Groundnuts</td>
<td>V</td>
<td>V</td>
<td>Y</td>
</tr>
<tr>
<td>ESA</td>
<td>Malawi</td>
<td>Faba bean</td>
<td>V</td>
<td>V</td>
<td>Y</td>
</tr>
<tr>
<td>ESA</td>
<td>Malawi</td>
<td>Glimmer</td>
<td>V</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>ESA</td>
<td>Malawi</td>
<td>Groundnuts</td>
<td>V</td>
<td>V</td>
<td>Y</td>
</tr>
<tr>
<td>ESA</td>
<td>Mozambique</td>
<td>Cowpea</td>
<td>V</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>ESA</td>
<td>Mozambique</td>
<td>Groundnuts</td>
<td>V</td>
<td>V</td>
<td>Y</td>
</tr>
<tr>
<td>ESA</td>
<td>Mozambique</td>
<td>Faba bean</td>
<td>V</td>
<td>V</td>
<td>Y</td>
</tr>
<tr>
<td>ESA</td>
<td>Mozambique</td>
<td>Lintil</td>
<td>V</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>ESA</td>
<td>Mozambique</td>
<td>Common bean</td>
<td>V</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>ESA</td>
<td>Mozambique</td>
<td>Cowpea</td>
<td>V</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>ESA</td>
<td>Mozambique</td>
<td>Groundnuts</td>
<td>V</td>
<td>V</td>
<td>Y</td>
</tr>
<tr>
<td>ESA</td>
<td>Mozambique</td>
<td>Lintil</td>
<td>V</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>ESA</td>
<td>Sudan</td>
<td>Chickpea</td>
<td>V</td>
<td>Y</td>
<td>V</td>
</tr>
<tr>
<td>ESA</td>
<td>Sudan</td>
<td>Common bean</td>
<td>V</td>
<td>Y</td>
<td>V</td>
</tr>
<tr>
<td>ESA</td>
<td>Sudan</td>
<td>Faba bean</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>ESA</td>
<td>Sudan</td>
<td>Sorghum</td>
<td>V</td>
<td>V</td>
<td>Y</td>
</tr>
<tr>
<td>ESA</td>
<td>Tanzania</td>
<td>Chickpea</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>ESA</td>
<td>Tanzania</td>
<td>Common bean</td>
<td>V</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>ESA</td>
<td>Tanzania</td>
<td>Common bean</td>
<td>V</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>ESA</td>
<td>Tanzania</td>
<td>Cowpea</td>
<td>V</td>
<td>V</td>
<td>Y</td>
</tr>
<tr>
<td>ESA</td>
<td>Tanzania</td>
<td>Finger Millet</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>ESA</td>
<td>Tanzania</td>
<td>Groundnuts</td>
<td>V</td>
<td>V</td>
<td>Y</td>
</tr>
<tr>
<td>ESA</td>
<td>Tanzania</td>
<td>Pearl Millet</td>
<td>V</td>
<td>V</td>
<td>Y</td>
</tr>
<tr>
<td>ESA</td>
<td>Tanzania</td>
<td>Pigeonpea</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>ESA</td>
<td>Tanzania</td>
<td>Sorghum</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>ESA</td>
<td>Uganda</td>
<td>Common bean</td>
<td>V</td>
<td>Y</td>
<td>V</td>
</tr>
<tr>
<td>ESA</td>
<td>Uganda</td>
<td>Finger Millet</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>ESA</td>
<td>Uganda</td>
<td>Groundnuts</td>
<td>V</td>
<td>V</td>
<td>Y</td>
</tr>
<tr>
<td>ESA</td>
<td>Uganda</td>
<td>Pigeonpea</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>SACC</td>
<td>Angola</td>
<td>Common bean</td>
<td>V</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>SA</td>
<td>India</td>
<td>Barley</td>
<td>V</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>SA</td>
<td>India</td>
<td>Chickpea</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>SA</td>
<td>India</td>
<td>Common bean</td>
<td>V</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>SA</td>
<td>India</td>
<td>Lintil</td>
<td>V</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>SA</td>
<td>India</td>
<td>Pearl Millet</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>SA</td>
<td>India</td>
<td>Pigeonpea</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>SA</td>
<td>India</td>
<td>Sorghum</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>WCA</td>
<td>Burkina Faso</td>
<td>Common bean</td>
<td>V</td>
<td>V</td>
<td>Y</td>
</tr>
<tr>
<td>WCA</td>
<td>Burkina Faso</td>
<td>Cowpea</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>WCA</td>
<td>Burkina Faso</td>
<td>Pearl Millet</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>WCA</td>
<td>Burkina Faso</td>
<td>Sorghum</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>WCA</td>
<td>Mali</td>
<td>Cowpea</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>WCA</td>
<td>Mali</td>
<td>Pearl Millet</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>WCA</td>
<td>Mali</td>
<td>Sorghum</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>WCA</td>
<td>Niger</td>
<td>Common bean</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>WCA</td>
<td>Niger</td>
<td>Cowpea</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>WCA</td>
<td>Niger</td>
<td>Pearl Millet</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>WCA</td>
<td>Niger</td>
<td>Sorghum</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>WCA</td>
<td>Nigeria</td>
<td>Common bean</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>WCA</td>
<td>Nigeria</td>
<td>Cowpea</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>WCA</td>
<td>Nigeria</td>
<td>Pearl Millet</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>WCA</td>
<td>Nigeria</td>
<td>Sorghum</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>WCA</td>
<td>Nigeria</td>
<td>Soybean</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>WCA</td>
<td>Senegal</td>
<td>Cowpea</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>WCA</td>
<td>Senegal</td>
<td>Pearl Millet</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>Zone</td>
<td>Country</td>
<td>Species</td>
<td>Yield Enhancement</td>
<td>Abiotic Stress</td>
<td>Quality</td>
</tr>
<tr>
<td>-------------</td>
<td>-----------</td>
<td>---------</td>
<td>------------------</td>
<td>----------------</td>
<td>---------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Quality</td>
<td>Drought</td>
<td>Nutrient-use efficiency</td>
</tr>
<tr>
<td>DCLAS</td>
<td>Egypt</td>
<td>Chickpea</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>Regional</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Focus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Countries</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CWANA</td>
<td>Egypt</td>
<td>Faba</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>bean</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kazakhstan</td>
<td>Barley</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Turkey</td>
<td>Barley</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Turkey</td>
<td>Chickpea</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Turkey</td>
<td>Lentil</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>ESA</td>
<td>Egypt</td>
<td>Chickpea</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kazakhstan</td>
<td>Barley</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Turkey</td>
<td>Chickpea</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Turkey</td>
<td>Lentil</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>ESA</td>
<td>Turkey</td>
<td>Chickpea</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Turkey</td>
<td>Lentil</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>ESA</td>
<td>Turkey</td>
<td>Pigeonpea</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nepal</td>
<td>Lentil</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>ESA</td>
<td>Nepal</td>
<td>Pigeonpea</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bangladesh</td>
<td>Chickpea</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>SA</td>
<td>Bangladesh</td>
<td>Lentil</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Myanmar</td>
<td>Chickpea</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>SA</td>
<td>Myanmar</td>
<td>Pigeonpea</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nepal</td>
<td>Chickpea</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>SA</td>
<td>Nepal</td>
<td>Lentil</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Myanmar</td>
<td>Pigeonpea</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>WCA</td>
<td>Ghana</td>
<td>Common bean</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bangladesh</td>
<td>Pigeonpea</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>WCA</td>
<td>Bangladesh</td>
<td>Cowpea</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ghana</td>
<td>Soybean</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>WCA</td>
<td>Ghana</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
FLAGSHIP 3: VARIETY & HYBRID DEVELOPMENT

RATIONALE

Flagship 3 of the Phase II CGIAR Research Program on Dryland Cereals and Grain Legumes (DCLAS) aims to develop products that satisfy the needs of smallholder farmers with regard to productivity, nutritional value, and market potential. The anchor crops of the program, generally categorized as “orphan crops”, as part of twenty-four such crops so classified, together covered 300 million hectares globally in 2012, with two of the target crops of the program, namely, sorghum and millet, alone occupying the same area as maize and wheat combined in sub-Saharan Africa in 2011 (Searchinger et al 2013; http://www.mars.com/global/african-orphan-crops.aspx.). DCLAS invests in a wide range of innovative agricultural products and services anchored on twelve target crops for productivity enhancements, agronomic solutions and livelihood improvements primarily in the drylands of Africa and Asia. Crop improvement research in DCLAS is addressed through two flagships, namely, Pre-Breeding, Trait Discovery & Development (FP2), and Variety/Hybrid Development (FP3). We plan to rapidly incorporate and mainstream advanced techniques in plant breeding and biotechnology into this variety/hybrid development pipeline during the period, 2017-2022, for fast and efficient product delivery tailored to end-use demand. Continuing on the successes and lessons learned from the Phase I activities of its commodity-based component programs, namely, Dryland Cereals and Grain Legumes, FP2 and FP3 of DCLAS will thus together maintain a rigorous variety/hybrid pipeline with products at various stages of development to enable continuous release and delivery of high-quality farmer-preferred products for efficient seed-replacement rates in the target production environments (Part I-Annex 14). Flagship 3 of DCLAS works downstream of Flagship 2, and in close association with it, for the final selection and further development of selected varieties and hybrids of the twelve target crops received from the latter. FP3 also facilitates the final release of new varieties and hybrids to appropriate production environments.

Increase in food security, and reduction in malnutrition and environmental pressures, especially land conversion, requires strong growth in crop productivity and improvement (Searchinger et al., 2014). The target crops of the program have specific significance to food security as they are adapted to extremely marginal agricultural lands where most the word’s poor and hungry live. As such, increasing the productivity of these crops to even half of their maximum yield potential has greater implications to the food security in sub-Saharan Africa than productivity improvements in any other crop (Nelson et al., 2014). It has been estimated that with a 40% increase in productivity of combined land, labor and chemical inputs over that currently projected for 2050, the number of malnourished children will be reduced by 19%, and the rate of increase in food prices will also be lower (Nelson et al., 2010). This required growth in crop improvement will need to occur in exceedingly difficult physical conditions imposed by changing climate and increasing water scarcity. Though higher yields in the current and the changing new environments require crop improvement research combined with agronomic management, it has been claimed that plant breeding alone contributed to half of all yield gains in the Green Revolution (Evenson, 2003). For the above reasons, although the target crops of DCLAS are almost always grown under low-input agriculture in our target countries relative to the high-input agriculture of the Green Revolution, improvement of their productivity through Flagship 3 (Variety/ Hybrid Development), in association with Flagship 2, will contribute to the grand challenges of competition for land, climate change, nutrition and diet diversity, and land degradation.

Increasing the rate of yield gain through conventional breeding requires a combination of (1) faster breeding pace through increased breeding-cycle number, shuttle breeding, and technologies such as doubled haploidy, and (2)
increased precision and efficiency of data generation and utilization through optimal field experimentation, prompt and open data warehousing, and digital solutions that allow seamless use of massive data. Faster genetic gains in our target crops, relative to the current state, are possible across all target regions merely by addressing the above, but even greater and faster step changes are realizable at the present time through the ready adaptation of learnings from the major food crops of the world, primarily maize in the private sector, regarding the use of the most advanced genomics technologies, bioinformatics and high-throughput analytical platforms. With such opportune timing, crop improvement possibilities for the target crops of DCLAS are poised for significant change, provided we establish at the earliest opportunity and streamline for highly-coordinated use, the necessary systems, processes and environments either directly through DCLAS or in collaborations and joint ventures with appropriate public- and private-sector entities. An important and consistent consideration for DCLAS throughout this process is the fact that sustainable livelihood improvements in our target countries require (1) careful considerations on site selections for the establishment of necessary facilities, (2) in-pace capacity development of collaborating NARS partners for sustainable utilization of cutting-edge technologies and analytical platforms, and (3) the coordinated development and deployment of crop improvement and crop management solutions within the context of end-user preferred cropping and farming systems.

As indicated before, the fundamental plant-science considerations for crop improvement primarily reside within, and are utilized for, Pre-Breeding and Trait Discovery of Flagship 2. In logical continuity to variety/hybrid development, the applied research aspects of environmental characterization for variety/hybrid testing, field phenotyping and location-adapted agronomic practices, and the operational and logistical aspects of nursery seed production, maintenance and variety/hybrid release fit within Flagship 3. Thus Flagship 3 collaborates closely with Flagship 2, upstream of it in the product pipeline, and Flagships 4, 5 and 7, all downstream of it. The Clusters of Activities for Flagship 3 are (1) Environmental Classification, target population of environments (TPEs) and Phenotyping, (2) Variety/Hybrid development; (3) Variety/Hybrid Adaptation Trials, (4) Variety and Hybrid Characterization, (5) Nursery Research & Seed Production, and, (6) Variety/Hybrid Release. FP 3 also includes innovative research in relation to these processes of varietal development and will work closely with FP2 on informatics approaches that can facilitate trait deployment in improved varieties.

**Innovative to 2017-2022 for FP3 are:**

1. Systematic identification and characterization of a Target Population of Environments across the target crops and countries, to facilitate efficient variety/hybrid selection, testing and release of individual crops, and the utilization of spillover opportunities across countries/regions
2. Establishment of one managed-stress environment for drought testing in the target region, in pilot mode
3. Evaluation, in pilot mode, of the feasibility and practical relevance of remote-sensing for field phenotyping in our target crops in the target ecologies
4. Establishment, in pilot mode, of a doubled haploid production platform for one crop, either new, or as satellite to existing CGIAR or industry facilities in collaboration or joint venture mode

**CLUSTER OF ACTIVITIES (CoA)**

DCLAS PRE-PROPOSAL
CoA 3.1: ENVIRONMENTAL CLASSIFICATION, TPEs AND PHENOTYPING: The prediction of genotype performance for yield and other agronomic traits in a target population of environments (TPE) is made possible by the correlation between genotype performance and environments using data on relative performance of genotypes in multi-environment trials (METs) (Basford et al., 2002). Phenotypic variation in target environments, and the genetic correlation between, and trait heritability in, the test and target environments, determine selection efficiency and the size of realized genetic gain in the TPE. A TPE is a set of target locations and future seasons, thus constituting a set of future production environments where varieties and hybrids from a breeding program will be grown (Cooper and Byth, 1996). For the combined realization of success and efficiency gains in a complex crop improvement program involving twelve target crops grown in at least three different production environments (arid, semi-arid, and humid tropic), it is important to (1) identify and understand the multiple production systems and TPEs of the different target crops of the program, (2) collect, update and classify environmental characterization data of both the test and the target population of production environments, and (3) utilize spillover opportunities for both testing and release across locations, production systems, and regions.

To this end, during 2017-2022, we aim to:
1. systematically catalogue, characterize and classify all production environments of the target crops in the target countries,
2. identify and define separate or overlapping TPEs for the target crops and their target production environments,
3. determine the existence, or lack, of representative selection and testing locations
4. complete spatial characterization of existing representative selection and testing locations, and establish new collaborative location networks (with CGIAR or non-CGIAR partners as required) where gaps exist
5. establish at least one pilot-mode managed-stress testing location to enable breeding for one critical trait, drought tolerance
6. systematically apply new and more precise statistical methods of experimentation that combines design information with spatial adjustment within and between trials
7. identify controlled-environment phenotyping parameters (physiological or metabolic) predictive of field performance, improve existing models that address GxE,M, and design target plant ideotypes
8. explore in pilot mode the feasibility and practical relevance of remote-sensing for field phenotyping in our target crops in the target ecologies, and
9. establish centralized biometrics facilities, cloud-based data warehousing and computing, and pedigree management and tracking systems for the application of optimal statistical design, analytical protocols and appropriate metadata standards

While mega-environment classification, characterization and identification of selection and testing sites have been addressed in some of the commodity component CRPs of DCLAS during the pre-reform period and also during Phase I, such efforts have not been systematic and pervasive within or across the participating centers of the program. The coordination of twelve crops, most of which are ideally suited to dry arid or semi-arid environments, within a single program opens up opportunities for efficiency and spillover gains through the systematic, stepwise implementation of this CoA. Particular emphasis will be placed on West Africa where two collaborating and interacting partnerships have been recently created, namely, IAVAO (Innovation and plant breeding in West-Africa) and LAPSE (Joint laboratory on the adaptation plant and associated microorganisms to environmental stresses), which are aligned with the regional initiatives, ECOWAS and World Bank (?) funded WAAPP. The recent convening of the partners involved in the IAVAO Partnership Platform (PP) in Montpellier identified the development of a field experimental network as a priority objective and a key landmark towards
the implementation of this integrative approach. This network will aim at providing experimental and breeding sites representative of the TPE in West Africa and equipping them to multi-environmental trials for GxExM analysis, genetic-material validation, and phenotyping of adaptive traits in West Africa. This partnership platform can also contribute to the Site-Integration Plan of the CGIAR in West Africa through DCLAS, for example, for companion crops like maize or rice. The proposed data-management system is the cloud-based implementation of the Breeding Management System of the Integrated Breeding Platform (IBP), which is a comprehensive suite of software capable of handling the complete cycle of breeding projects. The field testing locations developed by CoA 3.1 of FP3 will be used by both FP2 and FP3 for variety/hybrid selections and advancements.

CoA 3.2: VARIETY/HYBRID DEVELOPMENT: Deploying farmer preferred varieties, enhanced germplasm from pre-breeding activity in FP 2, and other improved germplasm as parental material, each crop breeding program will pursue its particular crop priorities. Production constraints are widely known and have been the object of breeding programs in Phase I and before, though a common denominator of most programs today is developing tolerance to the effects of climate change, especially excessive heat and drought. Priority traits are cited in FP 2, and parental material identified there, together with selection techniques, will be utilized in FP 3. Much of this labor will be carried out at the research sites of the CGIAR centers and of the more advanced national programs for breeding, while outsourcing of DNA analysis will be implemented in some cases. National programs whose agroecological conditions are representative of their respective region will be encouraged to share advanced material with neighboring countries.

CoA 3.3: VARIETY/HYBRID ADAPTATION TRIALS: This is corollary to CoA 1, which establishes the physical and analytical infrastructure and capabilities that enable the rigorous selection of breeding material in CoA 3.2 for confident selections and advancement decisions. While FP2 deals with the initial field testing of large numbers of pre-breeding material, the CoA3 of FP3 addresses the advanced material received from FP3 CoA2, where selections have already been filtered for only the most promising varieties or hybrids for advancement. Further, while FP2 deals with field testing over only two seasons, and at the most two locations, CoA 3.2 and CoA 3.3 tests a filtered set of smaller numbers of varieties/hybrids across multiple environments and a minimum of two seasons. Multi-environment adaptation trials, common to commodity programs across all sectors, including the CG, addresses the spatial and temporal adaptation to the prevailing set of soil, environmental and biotic conditions throughout crop duration across single or multiple seasons, and selects the best material for further advancement in the product pipeline, using yield as the primary criteria. During 2017-2022, we aim to systemize adaption trials, and advancement decision processes, across the target crops and countries of the program, and couple these to standardized data collection processes and storage. This will enable the query and utilization of the data for confident selections and advancements, and also provide a repository of data on crop performance coupled with environmental parameters that can support physiological modeling. In addition, during this period we aim to establish at least one managed-stress testing location in a target region for drought tolerance research, which will be used to evaluate and characterize advanced drought-tolerant material for tolerance to seedling drought stress, flowering-stage stress and grain-filling stress (Cooper et al., 2014). This will provide the bases for standardizing future Stage B and Stage C field drought screening under a managed drought-stress testing environment that offers multiple testing regimes.
**COA 3.4: VARIETY AND HYBRID CHARACTERIZATION:** This CoA will move beyond current modes and extents of variety/hybrid characterization, to a systemized and standardized process of pre-release variety/hybrid characterization, incorporating required specificities, for the target crops of the program across the target countries. This will enable the collection and storage of data for immediate and future use for variety/hybrid development from the perspectives of both fundamental research and practical considerations towards pre-release variety characterization. Such characterization will include both field characterization of important agronomic traits including yield component analyses and abiotic-stress tolerance, and controlled-environment characterization of nutrition and quality traits, disease resistance, insect resistance, and molecular characterization for subsequent tracking and impact analysis. Similar to the establishment and maintenance of testing locations by FP3 for the use of both FP2 and FP3, laboratory and controlled-environment facilities needed for variety and hybrid characterization in CoA 3.3 will be established/strengthened and maintained by the respective Trait Discovery and Development CoAs in FP2.

**COA 3.5: NURSERY RESEARCH AND SEED PRODUCTION:** Activities of this CoA are primarily aimed towards the operational research for the establishment, maintenance and efficiency improvements of centralized production-scale facilities for the production of quality foundation seed, breeding material, doubled haploids, etc., including the centralized maintenance of seed of important populations relevant to ongoing research. Though an essential pre-requisite for efficient crop improvement research, this again has not been pervasive across all of the current operations within the two commodity programs of DCLAS. The CoA will also address systematic naming of pedigree and curation of data and material. We intend to use successful models for these, leveraging capacity-development intentions of the seed industry. This CoA will also house a pilot mode doubled-haploid production facility focused on the one crop where induction of haploidy has already been demonstrated, namely barley, which will be established as a separate or satellite facility in collaboration with existing facilities of CG or private-sector collaborators, such as DuPont Pioneer.

**COA 3.6: VARIETY/HYBRID RELEASE:** Release of varieties or hybrids is a function of national institutions, often public but occasionally in the private sector, especially in the case of hybrids. Release of varieties/hybrids for production of seed and use as cultivars is normally regulated by a government agency that supervises officially sanctioned yield trials and validates some distinctive advantage of the candidate material. This might be some minimal yield advantage, or some specialty traits such as nutritional value or farmers/consumers acceptance. Although this process is in hands of partners and the respective agency, activities within the CRP can add support to this process. Definition of TPEs can orient the placement of official trials. Multilocational yield data can supplement the officially sanctioned trials, especially if the multilocalional trials are executed in regions that the official agency accepts as relevant to the recommendation domain. This implies forethought in coordinating these steps in the evaluation and release process such as close collaborations and/or partnership with releasing agencies. Some minimal amount of foundation seed (produced in CoA 3.5 above) is often a requirement for release.

**GENDER INTEGRATION:**
Crops under this CRP are often cited as women’s crops, especially in Africa, and this invites conjecture that improved germplasm will benefit women preferentially. This is possible but cannot be assumed, as improved
market potential may also induce men to dominate marketing of production. This requires careful monitoring. As posed in the TOC, market niches where women have a particular advantage are desirable. Fresh leafy vegetables such as cowpea leaves have been cited as one such niche, but such niches are likely to be very local. At very least, given the higher nutritional demand for iron among women, enhanced availability and increased consumption of dryland cereals and pulses ought to be beneficial to women.

PARTNERSHIPS:
Non-CGIAR Partners: ARI (Egypt), ARI (Sudan), BARI (Bangladesh), DARI (Iran), DRD (Tanzania), EIAR (Ethiopia), FAO, GDAR (Turkey), GRDC (Australia), IAEA, IAR (Nigeria), ICAR (India), IER (Mali), INRAN (Niger), ISRA/CERAAS (Senegal), INRA (Morocco), IIAM (Mozambique), KALRO (Kenya), Legume Innovation Lab, NARO (Uganda), NARC (Nepal), Peanut Innovation Lab, SMIL, Zamorano University (Honduras). (see also annex of existing partners)

Strategy to select partners: Some partners in FP 3 participate directly in the development of improved materials, including the creation of new cross combinations and segregating populations. These partners have a proven track record of performance in varietal development (for example, EIAR in Ethiopia), and while they typically represent countries with important demand for improved germplasm which alone justifies their inclusion, their research capacity is another significant factor. Other partners essentially test finished materials, either derived directly from international centers or through horizontal transfer from other institutions within a region. Their participation likewise is based on the demand and need for improved germplasm, but the relative investment for this activity is lower.

CAPACITY DEVELOPMENT
Enhancing capacity in a fast changing world of genomics is an on-going process for both international centers and for national programs, as genome analysis generates data in quantities that increase by orders of magnitude within a breeding cycle of a crop, and bioinformatics requires hardware fit for the job. Furthermore, as abiotic stress comes more forcefully to the forefront, for example, drought under climate change, reliable field phenotyping increases in importance. Compared to evaluation under optimal conditions, phenotyping under stress typically encounters much greater field variability. This requires special attention to agronomic management, and to field experimental design to deal with spatial variability. This is a new area for most programs and demands consideration in training. While capacity building is often centered on degree training, technician level training is one of the most valuable inputs for field oriented breeding, and is a large gap in most training programs. This must be addressed to strengthen national partner institutions.

THEORY OF CHANGE
The TOC is predicated on the assumptions posed in the rationale for this flagship – that these crops are essential for food and nutritional security of marginal populations, based on their rusticity and their nutrient concentration, and that they have multifunctional traits including market potential when production exceeds household demand. High current prices suggest that production is not adequate to meet demand, a conjecture that is confirmed, for example, by bean consumption studies in East Africa where the poor can only consume only 30-40% as many beans as the well to do. This leads us to propose that improved productivity will find a ready audience among the most needy if this leads to lower prices, accompanied by higher per capita consumption and nutritional benefits. Realizing this vision optimally depends on internal linkages within the CRP, taking advantage of breeding
technology in FP 2, and timely hand-off to FP 4 where “the rubber hits the road” with delivery. Beyond the breeding domain of FP3, the products of FP 3 will find ready adoption when they fulfill multiple purposes, and productivity will be enhanced when products induce investment under FP 5 –thus the necessity of clear demand driven breeding in response to findings under FP 1, and in response to market pull in FP 7. Impact –and change –will occur in proportion to the degree to which products meet needs, especially as niches for women and youth are revealed. We look forward to the prospect of identifying (through other flagships) germplasm products for which women and youth have a particular role in the production, transformation, and/or marketing. The Impact Pathway and Theory of Change for Flagship 3 are presented in FP3_Annex 1

CVs of the writing team are presented in Annex 15
FP3_Annex 1. Theory of Change and Impact Pathway
VARIETY AND HYBRID DEVELOPMENT

Assumptions and Risks
- High current prices suggest that production is not adequate to meet demand, a conjecture that is confirmed, for example, by bean consumption studies in East Africa where the poor can only consume only 30-40% as many beans as the well to do.
- Farmers accept and adopt the varieties developed
- Farmers through FP4 have easy access to seeds
- Release of varieties through NARS is expedited and there are series of products/varieties in pipeline to support in case a variety fails

Key:
- Enablers
- Output/outcome
- Cross CRP linkage
- Sub-IDO code
- CoAIf
- Intermediary outputs
- Assumptions
FLAGSHIP 4: SEED SYSTEMS AND INPUT SERVICES

RATIONALE
Outputs from investment in agricultural research like improved varieties and associated technologies should reach the majority of farmers to ensure national food and nutritional security and improve rural livelihoods. However, several studies across Africa and Asia shows variation among crops, countries and regions in adoption of dryland cereals (Ndjeunga 2007, Aw Hassan et al. 2008, Bishaw 2004) and grain legumes (Walker et al. 2014). Adoption rates are less than 35% and often much lower in drier areas. Adoption is limited because of technical, institutional, regulatory and policy constraints leading to poor technology transfer, seed provision and information about improved varieties of dryland cereals (Aw Hassan et al. 2008; Bishaw 2004), grain legumes (Bishaw et al. 2008; Abate et al. 2011; Rubyogo 2011). Several seed supply models have been tested across sub-Saharan Africa (TLII, 2015). Though the impact is increasingly being visible, it is still patchy and not widely spread across countries. The challenges in making these varieties more commonly available in sustainable and regular manner lie in adequate understanding of seed systems, seed value chain actors’ and information/knowledge gaps about the varieties and their characteristics. Given the limited commercial interest in legume and dry land cereals by private seed companies, the decentralized seed supply models (farmer-based seed production) in partnership with development organizations (Government, NGOS and Farmer organizations) who support the production of Quality Declared Seed have been instrumental in making varieties available (Rubyogo et al. 2010). Farmer-based seed enterprises proven successful and sustainable if established properly and provided with adequate facilities and linked to formal sector institutions (Tavva et al., 2010). However in some areas, the sustainability remains uncertain once the support is withdrawn (Source). Most recently, the use of small and affordable seed pack approach (across crops) has emerged as an alternative to facilitate access to seed by a larger number of farmers, particularly women and extending the use of quality seed to farmers and creating business opportunities for seed companies (TLII, 2015). On top of this, agro-inputs, post-harvest technologies, agro-advisory services and the financial services to acquire them are often inaccessible to farmers. All these challenges continuously resulted in lower yield at farm level.

Delivery systems of seeds of different crops, inputs and information do not work in isolation. Coordinated work across crops including legumes and dry land cereals delivery systems has the potential of diversifying seed producers’ portfolios, sustain their seed business and achieve better impact at scale than working on single crop and agro-inputs in isolation. This flagship proposes to critically review a range of seed dissemination models for legumes, and dry lands cereals and to identify promising and scalable models (or a combination thereof) to accelerate the supply of quality seed of these crops in targeted countries/region. It will also assess the basic information and complementary inputs/technologies should be delivered with seed to help farmers make informed choices on the varieties available and ultimately increase legume and dry land cereals productivity. Therefore, this study will produce the missing information that will guide the design elements for a sustainable and impact-oriented seed system to market improved varieties with a strong history of success more efficiently and widely.

The goal of the flagship aims to develop and implement collaborative strategies on how to build and strengthen partnerships to establish a robust seed system, including both the formal and informal seed sector, of dryland cereals and legumes in target countries of Africa and Asia for better seed delivery to enhance improved varietal adoption and return on research investments.

Objectives
- To systematically analyse the seed systems in the target countries with a view of determining the structure and performance of the dryland cereals and grain legumes seed sector and identify systemic bottlenecks and provide evidence based policy advocacy for investment and improvement
To actively catalyze partnerships mobilizing key stakeholders and creates seed delivery innovation platforms in order to enhance efficiency in accessing quality seed of new varieties by farmers

To improve access to yield enhancing inputs and educate providers of information to farmers that procure inputs in order to enhance local capacity to adopt and refine the use of these technologies

The flagship activities will be undertaken with the following assumptions:

1. Integrated strategies to seed and input delivery will lead to sustainable systems that support an increased availability of seeds, inputs and associated information to smallholder farmers, at scale.

2. Improved seed and input delivery systems in Africa and Asia will contribute to increased productivity and enhance smallholder farmer incomes, improve nutrition and provide opportunities for employment in agriculture

Links to grand challenges

1. Climate change: We contribute to addressing climate change by increasing the availability of seeds of improved, climate-resilient new crop varieties and associated agronomic practices.

2. Nutritious and diverse agri-food systems and diets: An increased productivity of legumes will lead to a higher availability of protein sources. A number of dryland cereals have high nutritive value and increasing their productivity will allow to maintain them in the crop portfolio in farms in dryland environments.

3. Employment and income opportunities created for men, women and youth as a result of the development of value chains for staple products and the provision of improved seeds, husbandry practices and small-scale mechanization. Through the development of seed value chain strengthening of seed companies and community seed producers, employment and income is being generated.

Questions to be addressed:

The Seed Systems and Flagship activity clusters will address the following research questions:

Seed systems: 1) What are the key policy, legal and institutional and technical constraints hindering the development of seed systems that deliver seed to small-scale farmers?, 2) Is the current variety development and release system efficient and effective in targeting small-scale farmers’ preferences and market demand?, 3) Is farmer led commercial seed production and delivery of dryland cereals and grain legumes economic and profitable?, 4) Is hybrid seed production technically feasible and economically viable for sorghum and pigeonpeas particularly in dry areas?, 5) Are alternative decentralized farmer-based seed delivery systems (community seed banks, cooperatives, farmer groups, etc) sustainable?  6) What are farmers’ seed commercial behavior, determinants of seed demand, and its implication on formal sector seed supply? 7) Can leveraging ICT make agro-dealer systems more efficient?

Inputs and agro-advisory services: 1) How can input services be made more accessible to farmers in rural areas?, 2) How can the handling and use of different types of inputs be made safer from supply to application?, 3) What is the relative efficiency, economic profitability and social acceptability of the different types of inputs? 4) How can Inoculants be delivered with legume seed where necessary?, 5) How can agro-advisory services around seed and input use be scaled up and become demand-oriented?

CLUSTERS OF ACTIVITIES (CoA)

COA 4.1 RESEARCH ON SEED SYSTEMS AND OTHER AGRO-INPUTS

Outcome delivered: Framework for seed sector analysis developed and enabling policy environment (briefs) developed leading to addressing farmers' varietal and seed demand
In almost all developing countries, the status of national seed system for dryland cereals and grain legumes is lagging behind compared to major food security crops like wheat, rice and maize. The failure for the emergence of a robust seed system is due to lack of enabling policies and farmers’ socio-economic circumstances. Moreover, past seed sector reports are more descriptive and less analytical. Systematic analysis of seed system would be initiated targeting selected countries at different stages of seed sector development. The review analyses the structure and performance of the dryland cereals and grain legumes seed sector and identify systemic bottlenecks and provide evidence based policy advocacy for investment and improvement.

Activities
- Cross-country analysis of the seed sector along the seed value chain
- Case studies on variety release mechanisms, farmers varietal preferences and seed commercial behavior to understand the seed market
- Review and evaluate alternative seed delivery models for dryland cereals and legumes
- Develop evidence-based for policy briefs for policy makers to support investment
- Determine the economics of commercial seed production of dryland cereals and grain legumes
- Develop evidence-based policy briefs for policy makers to support investment

The cluster outputs will be:
- A framework for seed sector analysis along the seed value chain;
- Well-informed knowledge of the functioning of seed systems;
- Software packages for certification procedures and provision of lab analysis results
- Better designed enabling policy environment for investments and incentives;
- Better regulatory environment for creating diverse seed systems (formal and informal);
- Better awareness of farmers’ varietal perceptions and demand for seed.

CoA 4.2 SCALING OUT SEED TECHNOLOGIES

Outcome delivered: Enhanced availability of quality seeds leading to the adoption of improved varieties/hybrids, and increase in on-farm yield of target crops.

There are several limitations in the seed delivery particularly the non-functional seed value chain with inadequate linkages between seed systems and grain markets, unavailability of all seed classes, inadequate demand creation and information flow and low capacity of value chain actors in pre- and post-harvest seed technologies. This flagship aims at actively catalyzing partnership to increase the level of professionalization and linkages in the seed value chains. It mobilizes key stakeholders and creates seed delivery innovation platforms where the roles and the responsibilities of each partner are defined along the seed value chain. This will enhance efficiency in accessing quality seed of new varieties by farmers.

Activities
- Design, test and deploy innovations aimed at improving linkages between seed value chain actors and grain market/utilization by using functional Innovation Platforms
- Design, test and deploy production and better access to early generation seed (breeder and basic), improving the availability of certified seed and Quality Declared Seed
- Design, test and deploy seed production arrangement aiming at improving the availability of certified seed and Quality Declared Seed by public sector, private sector entities and farmers
- Design, test and implement diffusion and marketing arrangements to enhance delivery and agro-enterprise development
- Facilitate release and commercialization of new varieties and enhance awareness of released varieties (popularization for demand creation)
- Establish and strengthen functional seed units to mainstream/institutionalize regular and sustained basic (foundation) seed production and provision
- Enhance local and regional capacities to produce, deliver, store and market seed

The cluster’s Outputs will be:
- Seed Value Chain Innovation Platforms piloted in target countries
- Capacity for varietal maintenance, production of breeder and foundation seed enhanced
- Availability and better access to early generation seed (breeder, basic) enhanced
- At least 2 new varieties of dryland cereals and legumes released in each country per year
- At least 40000 tons of certified seeds of diverse crops produced and marketed in Nigeria, 90000 tons produced and marketed in Ethiopia and 120000 tons produced and marketed in India.
- Training materials developed and disseminated to seed people and farmers

CoA 4.3 COMMERCIAL HYBRID SEED PRODUCTION
Outcome delivered: Increased capacity in hybrid seed production and better adoption and use of hybrids and seeds

Dryland cereal and pigeon pea hybrids with better tolerance to abiotic stresses such as drought, poor soil fertility and salinity and better resistance to biotic stresses such as insect pests and diseases, and thus with higher yields of both grain and fodder while maintaining preferred grain quality and processing characteristics would benefit farmers. Hybrid seed production of sorghum and pearl millets has shown success in India. An effort is being made in eastern and southern Africa to form a Consortium that will spearhead the creation of awareness and delivery of hybrid seed for dryland cereals. Apart from developing desired hybrids, there are technical and commercial constraints to address hybrid seed production of sorghum and millets in Africa. Hybrid production both for seed and grain requires special skills and experience in crop management to achieve high and stable yield under dryland conditions.

Activities
- Develop a robust Hybrid Parents Consortium by seed companies in target countries of Africa
- Investigate and validate techniques and profitability of hybrid seed production for sorghum and pearl millet particularly in dry areas
- Enhance the capacity of NARS partners in sorghum and pearl millet hybrid production to provide a sustainable pipeline of Parents for the consortium
- Create awareness and demand for hybrid seed among farmers through effective linkages with extension services and grain markets
- Sensitize public and private sector seed actors on the potential of dryland cereal hybrids as key opportunities for investments

The cluster outputs will be:
- A consortium of Companies formed in the target regions
- Hybrids with desirable traits identified and demonstrated and capacity of NARS enhanced
- Feasibility of hybrid seed production validated and demand created
- Public/private hybrid seed production and marketing initiated

**CoA 4.4 ACCESS TO PRODUCTION INPUTS**

**Outcome delivered:** Smallholder farmers have increased access to agro-inputs and use them safely within the regulatory framework.

Crop productivity can be efficiently enhanced by an integrated crop management combined with the use of quality seed of improved varieties and complementary crop management technologies such as effective and efficient use of fertilizers among several factors. Farmers will assess the value of bundling mini-packs of fertilizer and information with seeds, linked to agro-dealer/information providers at the point of purchase providing demonstrations and technical information to farmers. This will be supported by educational efforts targeted at information providers to support farmers that procure inputs, for enhancing local capacity to adopt and refine the use of these technologies.

**Activities**
- Data collection and surveys to capture supply and demand characteristics for agro-inputs (pesticides, fertilizers, biofertilizers for legumes) along the value chain, including post-harvest technologies
- Develop a database of agro-dealers and link it to a mobile phone based platform for information dissemination and enquiries by farmers
- Conduct demonstration trials, carry out comparative studies using different types of agro-inputs, ranging from synthetic chemicals to biological products, and evaluate them with farmers for their efficacy, economic profitability and social acceptability
- Assess local and regional needs for capacity building for farmers, professional sprayers, agro-input retailers and dealers, extension and NGO agents, in handling, applying and safe disposal of all categories of agro-inputs
- Develop and deploy new information and demonstration materials with regard to the above training needs, taking into consideration gender and literacy levels, and also taking advantage of modern ICT tools

**The cluster outputs will be:**
- A regularly updated list of agro-inputs available at the regional and country level, including safety classes and safer practices at the operator level.
- An interactive database that will provide information on inputs available with agro-dealers and information required
- A compilation of technical fact sheets for the above agro-inputs, which will include their efficacy, profitability and assessment by women and men farmers
- A new set of information materials on handling and disposing agro-chemicals, targeting the needs of the different actors along the grain legumes and dryland cereals value chains

**GEOGRAPHIES AND BENEFICIARIES**

**Countries:** Tier one  
Countries: The project activities will be implemented in a set of priority countries. Core activities will be implemented in Ethiopia in East Africa, India in Asia, and Nigeria in West Africa. In collaboration with bilateral and W3 projects, project activities will be scaled out to several other countries across Africa and Asia. These are given below.
Africa (Algeria, Egypt, Burkina Faso, Ghana, Kenya, Mozambique, Mali, Malawi, Morocco, Niger, Senegal, Sudan, Tanzania, Rwanda, Uganda, Zambia)

Asia (Afghanistan, Bangladesh, Iran, Kazakhstan, Pakistan, Syria, Turkey, Uzbekistan)

**Beneficiaries**
- Smallholder dryland cereal and grain legume women and men farmers
- NARES linked to agricultural extension services and private sector
- Seed companies, small and medium scale seed enterprises and farmer-based seed suppliers
- Market-oriented NGOs to promote seed distribution and linkages to markets
- NGOs with capacity to facilitate IPs and other scaling-up mechanisms
- Agro-input dealers and producers
- Farmer organizations and cooperatives
- Policy-makers (and organizations specialized in policy advocacy)

<table>
<thead>
<tr>
<th>Target countries / clusters / transects</th>
<th>Total population</th>
<th>Rural population (% total population)</th>
<th>Rural poverty headcount ratio at national poverty lines (% of rural population)</th>
<th>Malnutrition prevalence, weight for age (% of children under 5)</th>
<th>Agricultural land area (ha x 1000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nigeria (5 States in northern Nigeria)</td>
<td>178,516,904</td>
<td>53.0</td>
<td>52.8</td>
<td>26.7</td>
<td>72,000</td>
</tr>
<tr>
<td>Ethiopia (3 regions)</td>
<td>96,506,031</td>
<td>81.0</td>
<td>30.4</td>
<td>25.2</td>
<td>100,000</td>
</tr>
<tr>
<td>India (3 states)</td>
<td>1,267,401,849</td>
<td>67.6</td>
<td>25.7</td>
<td>43.5</td>
<td>179,300</td>
</tr>
</tbody>
</table>

**GENDER AND YOUTH INTEGRATION**
Agriculture plays a major role in economic development and growth and if translated into an inclusive growth it can help end poverty, reduce inequality and create opportunities for employment for women and youth. Access to productive assets like improved varieties and associated technologies would increase productivity and production and thereby better income and livelihoods of poor farmers including women and youth. It is envisaged that women and the youth can play an important role participating in local seed business and input delivery.

**PARTNERSHIPS**
This flagship will work closely with flagship 3 (breeding) to facilitate the release of varieties and promote their commercialization in each country. The flagship will also work with flagships 5 and 6 to not only enhance access to inputs but evaluate and promote the use of the inputs in order to exploit the potential of the improved varieties and close the yield gap on framers’ fields. Since any viable seed and other input business should be inclusive of other crops, this flagship will collaborate closely with the grain-based food systems CRP-MAIZE to promote viable seed and inputs systems in target countries.

<table>
<thead>
<tr>
<th>Partner type</th>
<th>Partner organization</th>
<th>Role in flagship</th>
</tr>
</thead>
<tbody>
<tr>
<td>CGIAR</td>
<td>ICARDA, ICRISAT, IITA Bioversity</td>
<td>Flagship and cluster research leadership. Lead design and establishment of research designs and protocols in collaboration with partners</td>
</tr>
<tr>
<td>NARS</td>
<td>IAR, Nigeria, State ADPs, Nigeria, National Extension services in target countries, Seed Regulatory bodies in Nigeria</td>
<td>Development and release of famer, market and consumer preferred crop varieties</td>
</tr>
</tbody>
</table>
** FLAGSHIP THEORY OF CHANGE & IMPACT PATHWAY **

A menu of well adapted and farmer/market/consumer preferred varieties and hybrids developed by NARS in partnership with DCLAS are the main input along the seed value chain. Availability and access to seeds of improved crop varieties is the most fundamental element in the impact pathway. The seed system analysis will diagnose systemic bottlenecks, identify opportunities, provide evidence-based policy advocacy to create an enabling policy environment for the development of an integrated, inclusive and robust seed sector. NARS will ensure a sustainable and regular supply of basic (foundation) seed of varieties and hybrids to both formal (public and private) and informal (farmer groups, communities) sectors which will be scaling out seeds catering to all farm typologies. Development practitioners and extension services will also play a key role in the provision of adequate information on varieties, recommended inputs and associated agronomic practices ultimately leading to the desired outcome of adoption at scale. Adoption of improved varieties and use of quality seed along with recommended inputs will lead to increased productivity of dryland cereals and legumes, thereby enhancing opportunities for value addition which will in turn lead to the desired impacts of increased incomes, better employment opportunities and better livelihoods for smallholder farmers including women and youth. Ultimately, this will have a multiplier effect along the seed value chain actors from product development to delivery contributing the reduction of both rural and urban poverty and in enhancing sustainable food and nutritional security at household levels. It is assumed that having the right policy environment would lead to the development of robust seed system that would produce and deliver sufficient quantity of seed of adequate quality at the right place and time and at reasonable price for farming communities. The risks are lack of policy support to attract

<table>
<thead>
<tr>
<th>Development partner</th>
<th>Ethiopia EIAR, ARARI, OARI, SARI and TARI India: ICAR and SAUs</th>
<th>Development and release of farmer, market and consumer preferred crop varieties Development and release of crop varieties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co-investment partner</td>
<td>Nigeria, CRS, SG2000,</td>
<td>Collaborate in scaling seeds to smallholder farmers.</td>
</tr>
<tr>
<td>Ethiopia</td>
<td>- Ministry of Agriculture and affiliated departments of production and extension - Regional/Zonal/District Bureaus of Agriculture - Ethiopian, Amhara, Oromia and South Seed Enterprises - Assela and Gonder malt factories</td>
<td>Demonstration and popularization of new varieties Scaling out seed to farmers Linkage of farmers to markets</td>
</tr>
<tr>
<td>India</td>
<td>-ICAR -National Seed Corporation (NSC), State Seed Corporations (SSCs) of different states, and private seed companies</td>
<td>Demonstration and popularization of varieties Seed production and scaling out seed to farmers</td>
</tr>
<tr>
<td>Co-investment partner</td>
<td>SG 2000, Nigeria, World Vision International Ghana, CRS Ghana, Nigeria</td>
<td>Underwrite collaborative scaling initiatives arising out of DCLAS research</td>
</tr>
</tbody>
</table>
private sector investment in seed delivery and poor market opportunities to attract farmers in adoption of dryland cereals and legumes. The Impact Pathway and Theory of Change for Flagship 4 are presented in FP4_Annex 1

**BUDGET**

This FP would initially need about 11.5 million US$ annually in W1 and W2 with 10% increase annually. Similar amounts would be needed in W3/Bilateral funding to enable us meet the country targets for seeds.

CVs of the writing team are presented in Annex 15.
FP4 Annex 1. Theory of Change and Impact Pathway
SEED SYSTEMS AND INPUT SERVICES

CoA 4.1 Research on seed systems and other agro-inputs → Policy related bottlenecks and intervention options identified C.1.3 → Improved seed marketing system (pricing, packaging, timely delivery, options) 1.2.1

FP: Priority Setting and Impact Acceleration

CoA 4.2 Scaling out seed technologies and agro-inputs
- Integrated seed technology promotion
- Inclusive Innovations Systems Platform A6

CoA 4.3 Commercial hybrid seed production
- Establish Hybrid Parent Consortium

FP 3: Variety & Hybrid Development

A5

A2

CoA 4.4 Access to production inputs:
- Demonstration trials, Timely Information access, Targeted Campaigns and Promotions

Communication and advocacy

A4

Integrated and improved access to seeds with agro-inputs 1.3.4 1.2.2

Smallholder farmers access and adopt improved seeds and production inputs without constraints

Assumptions and Risks
A1: Systematic and analytical analysis of seed sector will lead to enabling policies for development of a robust seed system and provide evidence based policy advocacy for investment and improvement.
Risk: Maintaining current policy environment (status quo) in research for development for dryland cereals and grain legumes (low government priority, investment, etc)
A2: Feasibility of hybrid seed production validated and demand created; Building partners’ capacities to provide a sustainable pipeline of parents for the consortium
A3: Public/private hybrid seed production and marketing initiated
Risk: Lack of private sector/farmers willingness to invest in seed business
A4: Local capacity needs to be developed and built
A5: Availability of well adapted and farmer/market/consumer preferred varieties/hybrids
A6: Functional innovation platform involving all value chain actors
A7: Better market opportunities for farmers leading to adoption and use of improved varieties and inputs
Risk: Limited market opportunities for farmers (low/unknown demand, low output price) resulting to low adoption
Others Assumptions: Adequate resources to undertake planned CoA activities
Other Risks: Climate change leading to emergence of new pests and diseases
FLAGSHIP 5: INTEGRATED LAND, WATER and CROP MANAGEMENT

RATIONALE
The integrated management of the natural resources (NR) base (water, land and biodiversity) of the crop-tree-livestock production systems is a key to improved productivity and sustainability especially in dryland environments. Major driving forces leading to unsustainable use of land, water and nutrients are causing a heightened level of resource depletion, inefficient use, loss of biodiversity, new insect pests, diseases and weeds with greater dependency on chemicals and antibiotics (Fraser et al., 2011; CGIAR ISPC, 2012). This requires greater investments to maintain or replenish the natural-resource base of the cropping systems. This flagship (FP5) will address the land, water, crop and livestock management issues in three major dryland Agricultural Livelihood Systems (ALS) namely, the rainfed, the agro-pastoral and the irrigated. In regions outside the drylands, where at least three of the grain-legume crops are grown, we plan to work in collaboration with other CG and non-CG partners, as necessary, to address agronomic research. As a component of the Agri-Food System (AFS) on dryland cereals and grain legumes, the activities of FP5 are integral to the CRP, and focus on managing and maintaining the NR base and integrating crop management options, including policies, institutions and markets, in a systems context. The Flagship will use an integrated approach to promote the efficient use of the NR base for sustained and enhanced crop and livestock productivity and smallholders’ livelihoods. FP5 will focus on the micro level of the scale continuum, namely, the field and farm household levels, with a strategy for out scaling to the landscape level and beyond through collaboration with FP6, WLE II, PIM, FTA, CCAFS and other AFS CRPs. FP5 together with FP6 will address the drylands biophysical, socioeconomic and livelihoods systems analysis following the merger of the DS CRP in DCLAS.

FP5 will contribute to the SLOs on improved natural resources and ecosystem services; improved food and nutrition security and; reduced poverty. It will overlap with the cross-cutting themes on climate change, gender and youth and include Big Data, ICT and capacity development. This can only be realized through adopting a new innovative approach of understanding, researching and optimizing the system functioning as a whole in response to farmers’ livelihood requirements. FP5 will provide the NR platform for each of the other FPs to position them in the system, and will research its improved linkages and performance for an overall improved system performance.

Links to grand challenges
a. Climate variability and change is one of the major challenges of dryland agriculture, especially in rain-fed systems at the farm scale. Efficient use of NR by adopting climate-resilient agricultural practices will enhance adaptation and to a lesser extent mitigation of climate change. FP5 will provide linkages to the integrative CRPs, CCAFS and WLE II.
b. Reducing risk through exploring crop intensification options of food and fodder systems with intercrops and sequential crops and improved short-season dryland cereals and grain legumes. Reducing abiotic stresses, and the cost of energy and labor cost integrated management.
c. Improving food security through enhancing productivity of food and fodder systems in smallholder farms.
d. Combating land degradation, restoring degraded lands and efficient use of water resources are prerequisites to sustainable and productive agro-ecosystems. FP5 will emphasize this close connection with WLE II, PIM and institutions of the UNCCD.

CLUSTERS OF ACTIVITIES (CoA)
CoA 5.1 WATER AND LAND ALLOCATION AND CONSERVATION: With increasing water scarcity and the impacts of climate change, the need to sustainably produce more with less water becomes increasingly necessary at the farm level. This activity cluster addresses improving water and land productivities and conservation through better management. This includes water and land use-efficient practices such as rainwater harvesting and conservation, deficit and supplemental irrigation, modernizing on-farm irrigation systems, scheduling and
allocating the available water resources to more water-use-efficient cropping patterns. The aim is to capture, store and efficiently utilize water and nutrient resources, optimize resource productivity, and reduce the vulnerability of the farmer to climate change and scarcity impacts.

**Questions to be addressed include:**

- **a)** How to allocate green and blue water resources conjunctively to improve rainfed systems performance and adaptation capacity to climate variability and change,
- **b)** How rainwater can be effectively utilized to improve crop and livestock productivity in the drier environments,
- **c)** Under what conditions can the adoption of water-use-efficient practices in irrigated systems be increased under the prevailing policies of water price subsidies,
- **d)** What are the major feedbacks and trade-offs among resource-conservation technologies, intensification, and diversification options? *(in collaboration with WLE II)*,
- **e)** How to allocate land among different crop-livestock options to enhance conservation of NR base, biodiversity and farm income *(in collaboration with FP1)*.

**Outputs:**

- **a)** Strategies for conjunctive management and use of green and blue water resources for improved rainfed systems assessed, acknowledging transactions cost, sustainability and changing climate,
- **b)** Feedbacks and trade-offs among resource-conservation technologies, intensification, and diversification options at farm level analyzed *(at landscape and basin level under WLE II)*,
- **c)** Framework, approaches and decision tools for enhanced adoption of water/land use-efficient practices in rainfed and irrigated/partially irrigated systems,
- **d)** Land-use planning options that optimize resource use, farm-family nutrition and income.

**Expected outcomes:**

- **a)** Farmers in at least 10 countries have adopted informed decisions on conservation and allocation of land and water for more productive and sustainable farming systems,
- **b)** Institutions in at least 5 countries utilize advanced modeling tools to optimize conjunctive use of green-blue water,
- **c)** Policy shift in at least 10 countries towards improved LWM; Local governments adjust policies to promote sustainable use of NR base.

**CoA 5.2 SUSTAINABLE LAND MANAGEMENT, RESTORATION AND CARBON SEQUESTRATION:** The relationship between land and livelihoods needs to consider not only the production of agricultural goods along an agri-food value chain, but also the broader aspects of how land can support livelihoods through opportunities for better landscape management. The issues of land tenure and undervaluing the land especially ignoring the indirect services it provides requires that we improve knowledge, monitoring and evaluation of the ecosystem services from land and how livelihoods can be linked to those services for the benefit of the rural poor. Drylands degradation is a major challenge to the livelihoods of rural poor people. This cluster will strive to achieve land degradation neutrality through two complementary initiatives:

- **a)** halting degradation on productive land and,
- **b)** restoring already degraded lands, thereby facilitating the attainment of viable livelihoods dependent on land resources. In addition, the role of carbon sequestration in sustainable land management under dry conditions will be explored in the context of climate change. The focus of research would be assessing methodologies for estimating and measuring the impact of land rehabilitation (and/or restoration) including carbon sequestration and frameworks for helping to synthesize effects on ecosystem services, economic and social impacts of the interventions. Assessing the economic benefits of sustainable land management will contribute to foresight analysis on what future farmers in developing countries will look like. Will they just be primarily seen as food providers as part of agri-food value chains or are they going to be seen as stewards of the land and landscapes as in Europe and elsewhere, and be financially compensated for this work in terms of schemes generally referred to as payments for ecosystem services? This cluster will be done in collaboration with both WLE II and PIM where complementarities can be identified.

**Questions to be addressed include:**

- **a)** Which gender- and age-sensitive tools can be developed to assess drivers of land- and water- management related ecosystem services across scales?
- **b)** How can genetic diversity and introduction of locally adapted varieties enhance the restoration of degraded lands especially those that are...
salt affected? 3) Which are key biophysical, technical, and social drivers associated with dryland degradation that affect land and water productivity? How can drivers be influenced to avoid degradation processes on a large scale? 4) How can the integration of traditional knowledge with empirical research and technology be enhanced to improve land and water rehabilitation and avoid degradation? 5) How can Sustainable Land Management (SLM) be out scaled? What is the methodology (theory) for out scaling? What criteria to optimize SLM at micro scale are different than that used macroscale and can we define suitable rules for upscaling and off-site effects? 6) What are the economic costs, benefits and risks of SLM practices under different conditions and how can the total economic value of land be used to influence policy making (in collaboration with PIM, WLE II and FP6)? 7) What policy incentives are needed to support local communities’ actions on SLM: participation in decision making process on land use and allocation; long-term land lease?

Outputs: a) Decision guides to target farm niches and clients in various farming systems, b) Sustainability indicators of diverse farm systems and key drivers of dryland degradation, c) Tools and frameworks for assessing land and water management, related ecosystem services, d) Tools and framework for restoration of degraded lands especially salt-affected soils using genetic diversity and SLM practices (in collaboration with WLE II -LWP), e) Ex ante assessment of economic benefits of SLM including total economic value of land to influence policy making (in collaboration with PIM and FP6), f) Strategy to encourage practices that promote improved carbon sequestration, and g) Evidence and framework to optimize SLM at micro scale and out scaling in collaboration with WLE II.

Outcomes: a) Partners and stakeholders use research outputs to strengthen their capacity to halt and reverse farmland degradation, b) Famers test and use recommended SLM practices in different locations to enhance ecosystems services and livelihoods, c) Stakeholders/governments use tools and frameworks in national programs to restore degraded lands, d) Farmers are equipped with knowledge, technologies, and planting materials to rehabilitate degraded lands and avoid land degradation, e) SLM plans incorporate best practices on biodiversity-land-water use practices, and f) Local communities use appropriate decision process in land management committees.

CoA 5.3 INTEGRATED SOIL-CROP-WATER-NUTRIENT MANAGEMENT: Farming-systems development through the introduction of a single technique or technology has little impact as it is strongly affected by other production factors. An integrated management approach is a more efficient way of meeting future food demands without undermining the integrity of the agro-ecological systems. This requires the understanding of soil, water, nutrients and crop interactions to better adjust the crop and genotype selection and management options to specific local conditions. This cluster will focus on modelling these interactions to identify ways of making the system more productive and sustainable.

Questions to be addressed include: a) How can soil-water-crop-nutrient modelling, coupled with geoinformatics, help identify entry points and address site-specific issues at the household level for improved decisions at the farm? b) How and where do conservation agriculture and diversity of crop varieties and livestock breeds contribute to NR conservation and sustainability? c) What are the functional strategies to scale up farm-level interventions under various socio-economic and governance arrangements? d) How will the use of crop and other residues for either soil improvement or livestock feed be considered as part of an examination of livelihood strategies and interacting value chains of crop and animal products? e) How can the benefits of biological nitrogen fixation (BNF) be increased in closing legume yield gaps to increase productivity of the systems?

Outputs: a) Interventions for efficient use of water and nitrogen to identify climate-ready cultivars (in collaboration with FP2/FP3), b) Sustainability indicators for existing farm practices across farm systems c) Options
for efficient use of land, water and nutrients to improve crop and livestock productivity and farm income using farm systems modelling and information management system, d) Intercrops and sequential cropping systems for efficient use of resources and sustained productivity, e) Recommendations for integrated and balanced nutrient management for optimal crop productivity, f) Synergies and trade-offs on a range of scenarios on technological interventions and resource constraints, and e) Improved legume-production recommendations integrated in the dissemination campaigns.

**Outcomes:** a) NARS use developed resources for efficiency improvements at farm level in pilot areas with their financial and environmental implications, b) Farmers and other stakeholders test new strategies to use efficient and sustainable systems for enhancing crop and livestock productivity and ecosystem services, c) Stakeholders and partners use the options available for increased diversification of locally adapted crop varieties and livestock breeds to low nutrient and water-scarce environments, d) Farmers/communities test options for improved gender and age-sensitive water-soil management for reduced yield gaps, e) Improved decision-making capacity at community, regional and national level to increase water-soil-crop management options, and f) Seasonal research campaigns towards legume intensification and yield gap closure implemented resulting in increased legume productivity.

**CoA 5.4 CROPPING PATTERN, SEQUENCE AND MANAGEMENT:** Dryland cereals and legumes are largely grown in monoculture rather than in rotations or combinations that can optimize nutrient use efficiency and lower the high risk of pest and disease incidence. Furthermore, the selection of associated crops/trees and livestock in the system affects water and land productivity biophysically, economically, socially and environmentally. The optimal crop and crop-variety mix and rotations are crucial decision-making tasks of the farmer from the perspectives of economic viability and ecological sustainability. This cluster will focus on options of crop and crop-variety mix, rotations and management to optimize productivity and enhance resource-use-efficiency in the context of agro-biodiversity and soil quality and health.

**Questions to be addressed include:** a) How do agro-ecological settings, enabling conditions, market opportunities and farming systems determine the options for NR management that will result in more resilient, profitable and nutritiously secure livelihoods? b) What simple and open access tools can small farmers use on near real-time systems (e.g., earth observation system) to optimize on-farm cropping patterns/rotations and profitability without compromising the system sustainability? c) What patterns of land use optimize productivity while conserving the NR base?

**Outputs:** a) Suitable synergistic systems in rotation for crop intensification and diversification with intercrops/sequential crops based on potential length of growing period of the region assessed, b) Suitable dual-purpose and disease-resistant cultivars to improve systems productivity and fodder availability, and c) Assessment for inclusion of leguminous annuals and tree crops into dryland systems for enhanced ecosystems services.

**Expected outcomes:** a) Sustainable cropping system that would be economically viable and environmentally friendly tested at large scale in participating countries, b) Farmers in designated areas use cropping systems and rotations developed by the program for enabling sustainable NR use, optimize farming profitability and system sustainability, c) Stakeholders use tools, cropping systems to promote diversified, profitable and sustainable crop-livestock systems, d) Proven improvements to soil health, agro-biodiversity, food and nutritional security under marginal dryland systems tested at large-scale pilot areas, and e) Farmers in stressed environments are presented with better crop mixtures and crop rotation management strategies.
**CoA 5.5 MECHANIZATION OF FARM OPERATIONS:** The focus of this cluster is on the mechanization of small-farm agricultural operations for enhancing farmer-, water- and land-sustainable productivity and reducing cost. In SSA, despite the availability of land, farmers have been partly constrained to grow enough food due to limited access to low-cost mechanization options. The cluster will research the biophysical aspects as well as the arrangements for individual and collective mechanization with the aim of facilitating cost-effective machines for small/medium size farms.

**Questions to be addressed include:** a) What are the farm-mechanization options that are self-sustaining, enable timely operations, improve productivity/efficiency and reduce drudgery in smallholder farms? b) How can smallholder farmers adopt appropriate mechanization effectively at low cost and what modalities can be used including the role of private sector and policies? c) How can mechanization along with near-real time earth observation support adoption of low-cost and energy-precision agriculture for NR-, labour- and input-use efficiency? d) What types of collective arrangements are required to facilitate introduction and adoption of low-cost mechanization options on a large scale? e) What is land and water productivity and its pattern and spatial variability (inter and intra field) for designing effective and efficient water allocation under persisting weather as well as long-term climate scenarios?

**Outputs:** a) Assessments for small-farm mechanization options to conserve scarce NR and crop management to save labor, time, and energy for enhanced productivity under dryland systems, b) Crop-specific mechanization strategies for harvest and post-harvest processes tackling extreme climate events to save time, labor, and transport, and storage losses, c) Collective arrangements/business models for smallholders to enhance access to low-cost farm mechanization, and d) Strategy to reduce costs of draught power through developing alternatives.

**Outcomes:** a) Sustainable farming options with reduced number of inefficient draught animals and associated environmental costs, b) Efficient farm operations used by NARS to improve productivity and reduce post-harvest losses and labor costs, c) Appropriate framework used for self-sustaining farm mechanization options enabling timely operations, improved productivity/efficiency and employment opportunities to youth and reduced drudgery especially for women, d) Stakeholders/local governments use the developed framework/approach to promote farm mechanization for small-farm systems, and e) Labor-saving gender- and age-sensitive technology that is adapted to locally adapted crop materials for home consumption and markets used by a number of farmers is study areas.

**CoA 5.6 SUSTAINABLE MANAGEMENT OF BIOTIC STRESSES:** Arthropod pests, diseases and weeds are a continuing threat to dryland-cereal and grain-legume crops, and it is anticipated that their negative impact on production will increase with climate changes. Integrated Pest Management (IPM) is an ecosystem approach to crop production and protection that combines different management strategies and practices to grow healthy crops and minimize the use of pesticides with considerable success. This cluster will assess the impact of climate change on biotic stresses, and evaluate IPM options in relation to resistant varieties (from FP2), crop varietal mix, application of crop-protection products (from FP3), agronomic practices, ecological engineering and beneficial organisms. Also the cluster will develop and deploy biological control options and biologically-based pesticides to sustainably manage biotic stresses, while preserving human and environmental health, and creating income opportunities for youth and women groups. The cluster will enhance the capacity of research and extension partners in the development and deployment of sustainable solutions to biotic stresses. Weeds are the primary competitors of crop plants for light, water, air, and nutrients, and can reduce or inhibit growth and farm income.

**Questions to be addressed include:** a) What is the knowledge gap with respect to plant biotic stresses and environment interactions as mediated by climate change? b) How can farmers make informed decisions about
IPM options to be deployed to suit regionally and locally different agronomic and environmental factors? c) How can bio-diversity and ecosystem services be better harnessed to produce good quality, efficient, beneficial organisms including bio-pesticides and biocontrol agents? d) What are the best options for integrating community-based organizations, farmer organizations and ultimately the private sector for out scaling IPM? e) At what levels and scales can increasing the diversity of crop varieties and animal breeds reduce the dependence on chemical pesticides, fertilizer, hormones and antibiotics to combat pests, diseases and weeds? f) When and in which crop-livestock-pest-disease systems can integrated management practices reduce the probability of future production losses to pest, diseases and weeds, while at the same time enhancing current production? g) What are the IPM options that can be disseminated to control the pests without negative effects on human health and that of the ecosystem? h) What gender- and age-sensitive information systems need to be in place to enable local communities easily access and share data on crop and livestock diversity to manage pest and diseases? i) Which cereal and legume crops in intercropping or sequential cropping with allelopathic effects can be introduced to control diseases and suppress weed growth?

Outputs: a) Up-to-date information with regard to insect pests, diseases and weed taxonomy, distribution and population dynamics at regional and local scale, including data on interactions with climate change, b) Updated damage thresholds for key biotic stresses in different agro-ecologies, c) Updated knowledge on biotic stresses–host plant and animal–landscape interactions, d) Tools to evaluate the amount and distribution of genetic variation within crops needed to limit pest and disease infestation over spatial and temporal time scales, e) Tools to measure crop vulnerability to future changes in pest biotypes and pathogens for dryland cereals and grain legumes, f) Novel ICT tool to allow dryland-cereal and grain-legumes women and men farmers access to real-time information with regard to IPM innovations and applications, g) Updated knowledge on population genetics of key biotic stresses, and of natural regulating organisms, and h) Efficient, economically profitable and socially acceptable crop protection products validated in FP3, including new-generation synthetic pesticides, novel bio-pesticides, endophytic organisms, RNAi and semio-chemicals applications,

Outcomes: a) Women and men scientists and extension agents are better tooled to develop and deploy sustainable IPM options against insect pests, diseases and parasitic weeds, b) Farmers can make better informed decision for applying economically profitable, environmentally sustainable and socially acceptable IPM techniques against insect pests, diseases and parasitic weeds, c) Policy makers in the participating countries are better informed about IPM approaches and develop laws enabling the development and deployment of such options, including biosecurity aspects, d) The area devoted to sustainably-managed agricultural production systems with reduced chemical inputs is improved through increased use of IPM and diversity rich solutions, e) Farmers are presented with methods and locally adapted materials to ensure sustainable agriculture under changing pest, pathogen and weed conditions, and f) Communities and other stakeholders gain from benefit sharing mechanisms that support IPM and diversification of varieties.

GEOGRAPHY & BENEFICIARIES
Of the 17 target and 16 associated countries identified for DCLAS, FP5 will seek agreements of partners and other FPs to select a limited number of research sites to implement an integrated system research coupled with an out scaling strategy. FP5 suggests the following integrated research sites: Rainfed ALS: Ethiopia, Morocco and India; Agro-pastoral ALS: Kenya, Tanzania, Uzbekistan; Irrigated ALS: Nigeria, Egypt and Sudan. Country-specific details are presented under Part I – CRP Level Summary Narrative, Table 1.

PARTNERSHIPS
Core partners of FP5 are ICARDA, ICRI SAT, IITA, ICRAF and Bioversity. However other potential partners include mainly WLE II, FAO, UNEP, USAID, USD A, IFAD, AFESD, GIZ and IFPRI. FP5 will continue to foster
strong partnerships with national programs of the participating countries, as well as with SROs such as CORAF/WECARD in West Africa. FP5 will also maintain current partnerships, and seek new ones, with advanced research institutions, organizations and collaborative research programs such as the USAID-funded Feed the Future Legume Innovation Lab.

Stakeholders of FP5 are the same as for the whole DCLAS. Rural poor farmers mainly dependent of scarce and vulnerable natural resources base to produce their food and make their livings are the main stakeholders. Farmers’ institutions and associated agribusiness are also among the primary stakeholders. NARS and local research and extension organizations will play important role in adapting outputs to farmer’s conditions. Also including the policy makers and the private sector in countries involved.

FP5 is an integrative component of the crop-tree-livestock system. It focuses on management of the NR base on which the research of the other six FPs is based. In particular, the livelihoods system modelling in FP6 and the policies, institutions and gender in FP1 are critical overlaps and channels for exchange of information. Crop improvement and seed FPs research cannot be optimized without integration with water, land, IPM and the ecological services that are generated. An important linkage is needed with WLE II CRP. Interactions between field and farm levels of FP5 with landscape/watershed levels in WLE II are important. Upstream downstream consequences of interventions are another linkage. In-situ vs. macro level modelling is another linkage. FP5 can also benefit from the research in PIM especially on policies, benefit sharing and institutional arrangements for adoption of research outputs. Strong linkage will be established with CCAFS with respect to local downscaling of climate change parameters and modalities for assessing the impacts of climate change on the farming system and NR, and the designed interventions to cope with its impacts. IPM and crop and livestock biodiversity linkage to ecosystem sustainability is central and both provide ‘docking’ into WLE II. Managing abiotic (increased unpredictability in rainfall patterns) and IPM will be linked with CCAFS to study the impacts of climate change, developing pest risk maps and impacts of CO₂ and temperature on diseases, insect pests and weeds dynamics. FP5 linkages with other DCLAS Flagships and other CRPs are presented in FP5_Annex 1.

FLAGSHIP THEORY OF CHANGE & IMPACT PATHWAY

The impact of FP5 will be achieved through communities adopting the outputs of the AFS on DC and GL where a generalized pathway to impact is being developed. However, this impact will be realized only with the realization of the role of the NRs and crop management in AFS function and performance. FP5 will implement an integrated approach to sustainably improve crop and livestock productivity and quality through improved efficiency in the use and management of the NR base, and mechanization, and through reduced yield gaps with integrated management of insects, pest, weeds and diseases. Socially acceptable, economically feasible and sustainable interventions on integrated land, crop, livestock and water productivity together with adaptive governance, enabling policies and enhanced institutional setups would lead to adoption and the impact of research outputs at large scale. Consequently this will provide a basis for improved livelihoods and agricultural eco-systems services. The focus will be not only on total farm productivity and quality of products with the greatest relevance to small holder farmers, but also on trade-offs with efficiency, social, gender and intergenerational equity. The Impact Pathway and Theory of Change for Flagship 5 are presented in FP5_Annex 1

FP5 will, as a minimum, produce the following IPGs:

- Efficient integrated management practices for improved crop, water, land & nutrient productivity/efficiency suited to variable and changing climates and farming systems in dryland settings,
- Climate-resilient, on-farm water and land use practices for improved productivity of the rainfed, irrigated and agro-pastoral food systems
- Sustainable land management/restoration options and out scaling strategies

DCLAS PRE-PROPOSAL 62
d. Strategies facilitating small holders’ use of appropriate mechanization and agri-informatics for precision agriculture and more efficient use of NRs, labor, inputs and energy at the farm scale.

e. Strategies integrating conservation technologies with production solutions to crop and livestock production related constraints.

f. Diversification and intensification of the production system through suitable expansion of cropping system and crop variety options.

g. Integrated Pest Management (IPM) strategies for economically strengthening biological control of pests and diseases, reducing chemical and antibiotics use, and enhancing crop and livestock biodiversity in the ecosystem.

h. Effect of climate change on pest distribution, natural enemies, expression of resistance, pest forecasting, and effectiveness of IPM technologies for pest management.

i. Development of indices for measuring resilience and sustainability at system level.

j. Integrated assessment models for system-level analysis of targeted interventions.

References:


CVs of writing team members are presented in Annex 15.
FP5, Annex 1. Theory of Change and Impact Pathway
INTEGRATED LAND, WATER & CROP MANAGEMENT

Farmers adopt integrated & efficient LWM packages
CoA: 5.1 Water and land allocation & conservation
CoA: 5.3 Integrated soil-crop-water-nutrient management

Stakeholders adopt and promote SLM practices & land restoration progress
CoA: 5.2 Sustainable land management, restoration & Carbon sequestration
CoA: 5.4 Cropping pattern, sequence and management

Sustainable, safe & lower cost crop production
CoA: 5.6 Sustainable management of biotic stresses
CoA: 5.5 Mechanization of farm operations

Assumptions
- A1: National partners and stakeholders including government understand, adopt and promote the frameworks, tools and approaches; capacity of partners and NARS are built
- A2: Knowledge gap is reduced; communities accept and use novel and new pesticides; farmers are convinced that the new pest protection options are sustainable.
- A3: new varieties that are climate ready, dual purpose, machine harvestable and disease resistant are readily accessible and accepted by the farmers
- A4: Farmers accept and diversify crops suitable for integrated crop-livestock systems
- A5: Collective arrangements/business models for smallholders to enhance access to low cost farm mechanization are in place
- A6: Scientists and extension agents adapt and deploy gender sensitive sustainable IPM options against insect pests, diseases and parasitic weeds.

Key
Enablers | Output/outcome | Cross CRP linkage | Sub-IOO code | CoA | Intermediary outputs | Assumptions
DCLAS PRE-PROPOSAL
FLAGSHIP 6: Improved Rural Livelihood Systems

RATIONALE

The livelihoods of farmers in the tropical and sub-tropical drylands are based, to a large extent, on cereal-legume-livestock farming systems. They face increasing pressure from demographic and climate change resulting in widespread land fragmentation, land degradation, water scarcity, food insecurity, unemployment – particularly of youth – and migration. The Improved Rural Livelihoods Systems (IRLS) flagship will focus on understanding and improving the performance and resilience of household livelihood systems in drier areas. It will also consider, either directly or in collaboration with other DCLAS flagships and other CRPs (in particular with WLE and PIM), the implications of how these interact with other systems at both larger and smaller scales. Special attention will be paid to the natural resource base and enabling and constraining environments for innovation such as markets, policies and institutions. IRLS aims to strengthen positive interactions amongst agricultural livelihood components – including dryland cereals, legumes, livestock, trees and vegetables – as well as taking into account the implications of non-agricultural components (e.g. off-farm income) for livelihood enhancement. It recognizes that dryland populations are particularly vulnerable to natural and social shocks and stresses such as droughts, dropping water tables, or civil unrest. Therefore there will be special emphasis on the resilience of the socio-ecological systems. The flagship will further consider the goals and perspectives of people in particular with regard to change and innovation. The goal of the flagship may be stated as:

Rural livelihoods are improved by capitalizing on the synergies and managing the trade-offs that exist within livelihood systems and with the wider contexts in which they operate.

In order to achieve this goal, the research conducted by the flagship will be directed at achieving the following five objectives:

- To increase livelihood resilience for households and communities in the face of climate change and other risks
- To improve livelihoods through diversification and value addition
- To intensify agricultural production systems in a sustainable manner
- To enrich plant and animal biodiversity for multiple goods and services
- To enhance the wider contexts for systems change (market development, landscape integrity, enabling and equitable policies and governance).

Although a production-based focus on single commodities has contributed to the achievement of the goals of the CGIAR, it has paid insufficient attention to the interconnections among different components of farming and livelihood systems; namely, to the environmental, institutional, gender, and equity-related dimensions of livelihoods and to trade-offs, non-linearity and tipping points. This has resulted, in some cases, in challenges for scaling-up innovation leading to low adoption rates and subsequent dis-adoption and in other cases in negative, unintended consequences for resilience, equity, and environmental sustainability and compromising beneficial impacts on food security and poverty. IRLS will use systems science to account for these shortcomings while addressing the problems outlined above. It will add value to DCLAS by mainstreaming systems thinking in the program so that its research outputs may be more sensitive to the following considerations and assumptions:

- Smallholder farmers manage systems, not components. Their management strategies implicitly address synergies and trade-offs amongst system components. The systems science in DCLAS must help to ensure that
the innovations it generates are compatible with farmers’ management objectives without compromising the interest of the wider community or of generations to come;

- The introduction of new component technologies can have impacts in other system components that are not always desirable\(^7\); Embedding the component research that DCLAS will conduct in a systems context can help to identify these complexities and avoid potential pitfalls;

- The adoptability of an intervention – innovation whether generated from research or elsewhere – is not just governed by factors that are intrinsic to that intervention and thus need to be holistically evaluated in a well-defined system context with a significant extrapolation domain.

- Increased access to and opportunities for participation in markets by households are key drivers of change in rural societies. Markets are more than value chains of particular crops. They are complex institutions of exchange, with specific spatial characteristics and temporal dynamics that involve network effects and entail important transaction costs. Households can face important challenges to participate in and benefit from rural markets, both as producers and consumers of agricultural products. Understanding market complexity and addressing the shortcomings rural households face while participating in them are crucial for improving their livelihoods in the drylands.

- The entry points for system innovation will depend on the system under consideration, its threats and opportunities. The DCLAS region is home to widely differing systems ranging from (agro-)pastoral to irrigated with equally different opportunities and threats. Prioritization and targeting of entry points will need to take account of system resiliency and social mobility as it aims to improve household livelihoods and ensures ultimate relevance of the research.

Moving towards a livelihoods systems approach will help to improve the compatibility of the agricultural innovations generated by DCLAS with the broader dimensions of household livelihood security and community interests, as well as enhancing equity and creating favorable enabling environments.

IRLS will implement its research through a set of five interacting clusters, each of which prioritises a particular dimension of strengthening livelihoods; i) system-specific *ex ante* analysis and prioritization ii) testing, adaptation and validation of options iii) implications of scaling across landscapes iv) enabling environments for widespread adoption, and v) multilayer institutional environments. This sequence of activity clusters corresponds to the scheme on mission critical areas presented by the CRP-DS Task Force (http://www.cgiar.org/who-we-are/cgiar-fund/fundcouncil/fund-council-meetings/13th-fund-council-meeting)

**Issues to be addressed:**
The IRLS activity clusters are designed to address the following generic research questions:

- What are the most important dimensions of our target livelihood systems and how do these interact with each other?
- What are the entry points in dryland livelihood systems for which research can generate sustainable options for reducing poverty and improving food and nutrition security and health?
- What are the most important characteristics of dryland livelihood systems that influence uptake and impact of interventions and how do they exert their influence?
- Which typologies of beneficiaries / households can support improved targeting of innovations?
- What combinations of crop-tree-livestock activities are most effective in sustainably reducing poverty and improving food and nutrition security and health?
- What factors govern the effective dissemination of research for impact at scale and what processes can be designed to accommodate these?

\(^7\) The rejection of short-strawed cereal varieties by crop-livestock farmers is a much-documented example of this.
What are the critical ecosystem services required to make the target livelihood systems sustainable?

How can intensification of DCLAS livelihoods systems also contribute to the mitigation of environmental “bads” (e.g. land degradation, loss of biodiversity)?

What roles do markets, institutions and policies play in the adoption of DCLAS interventions and how can these be strengthened?

**CLUSTERS OF ACTIVITIES (COA)**

**CoA 6.1 SYSTEM-SPECIFIC EX ANTE ANALYSIS AND PRIORITIZATION:**

*Outcome delivered:* Farmers offered more effective livelihood options for systems intensification, diversification and resilience.

The main focus of this cluster is on using the knowledge generated from Flagship 1 and other sources to identify, characterise and prioritise the livelihoods outcomes that are likely to result from different interventions or combinations of interventions implemented at household and other scales. The research conducted by the cluster will be iterative and securely embedded in the research of the other flagship clusters as well as informing and being informed by the activities of other flagships. It will inform the WLE flagship on Land and Water Solutions and Sustainable Intensification (LWS) in their nested scale approach to broaden uptake.

Appropriate systems simulation and trade-off models will be identified and enhanced, as required, in collaboration with Flagship 1. Household typologies (Flagship 1) will be validated and incorporated into these models for *ex ante* impact assessment across the DCLAS geographies. “What if” questions will be framed by the research questions and hypotheses underlying the flagship impact pathway and adjusted to be relevant to specific regional contexts. These will then be used in a series of *ex ante* impact analyses, complemented by participatory validation exercises to arrive at a set of option portfolios for improving livelihoods. The impact assessments will focus on delivery of sub-IDOs relating to productivity improvement, income generation, environmental sustainability and preservation of biodiversity, climate change adaption and mitigation as well as enabling environments for adoption and scaling. They are likely to include choices of crop-tree-livestock species and varieties, associated management practices and natural resources management by households to improve the quality and resilience of household livelihoods. Application of the models identified across typologies will strengthen foresight studies conducted by Flagship 1 and in other CRPs (e.g. by the Livestock CRP’s Livelihoods and Resilience Flagship).

*The cluster outputs will be:*

- A common analytical approach for *ex ante* impact assessment using complementary system modeling methods and tools that range from system-narratives to quantitative systems models as well as participatory integrated intervention assessment and scenarios development.
- Estimates of whole farm performance including productivity, profitability, risk and resilience related to sub-IDOs and off-farm opportunities of multifunctional agricultural systems under different intervention options for systems evolution and across typologies.
- Key trade-offs elaborated amongst productivity, intensification, diversification and ecosystem service delivery options, environmental footprint, resource-conservation technologies and effects on livelihoods, vulnerability and equity of alternative strategies established under different levels of market access and climatic variability.
- Target livelihood system sites identified and potential for scaling out assessed. Contextual conditions for scaling out also identified and geographically mapped.
- Implications of systems evolution strategies for climate change adaptation and mitigation elaborated.
COA 6.2 TESTING, ADAPTATION AND VALIDATION OF OPTIONS

Outcome delivered: Tested, adapted and validated options applied for sustainable intensification and livelihood diversification applied by farmers.

This “on-the-ground” cluster of activities will integrate, adapt and validate promising innovations (evaluated under Cluster 6.1) that contribute to the flagship goal. Multi-stakeholder engagement will play an essential role in ensuring the viability and adoptability of the innovations so farmer participation, development partnerships and the engagement of formal and informal innovation platforms will be required. Much of the initial prioritization for the cluster activities will come from Flagship 1 and Cluster 6.1 activities while lessons learned under this cluster (6.2) will feed back to strengthen ongoing systems analysis and modeling. The cluster will need to establish strong links to the activities of Flagship 5 on synergistic cropping systems, and efficient use of land, water and nutrients to improve crop and livestock productivity and farm income using farm systems modelling and information management system.

A coordinated set of research activities will be designed and implemented to elaborate effective integrated, adapted and validated interventions in existing productions systems, involving various combinations of crop, tree, livestock and resource management options that will enhance livelihoods outcomes and / or the resilience of target systems. These activities will also identify, implement and test, with appropriate partners, the complementary innovations that are required in the enabling environment to facilitate innovation and adoption at the household and community scale. Engaging with development and other partners will allow us to design and implement research in development programs that will clarify the activities and processes required to spread these portfolios over larger scaling domains (for more detailed study and implementation under Cluster 6.4). Monitoring data will be gathered, collated and interpreted using the indicator framework and sampling frames developed by Flagship 1.

The cluster outputs will be:

- Portfolios of household activities, enterprises and management practices that materially and equitably enhance livelihoods (as defined at sub-IDO level).
- Clearly defined and achievable enabling conditions for these improvements in livelihoods are realized.
- Evidence that these household interventions, in a favourable enabling environment, can generate beneficial impacts on CGIAR sub-IDOs at scale.

CoA 6.3 IMPLICATIONS OF SCALING ACROSS LANDSCAPES

Outcome delivered: Identify strategies (portfolio revision, governance options) for mitigating negative impacts at scale.

The research conducted under this cluster recognizes the importance of scale effects that amplify and multiply the impacts of household interventions when these are distributed across a landscape. These may take the form of feedbacks with both negative and positive implications for livelihoods. Cluster activities will also focus on how farmers/community members are influencing or being impacted by existing governance structures and resource management practices and how improved governance and resource management options can enhance ecosystem services while sustaining enhanced livelihoods. The cluster will need to establish strong links to the activities of Flagship 5 and flagships within other programs such as the LWS Flagship in WLSE that will promote the uptake of solutions beyond the landscape scale and across ecosystems.
Critical ecosystem services (e.g. mitigation of land degradation, protection of biodiversity, mitigation of GHG emissions) will be identified and evaluated in the key ecologies that sustain the agricultural livelihoods targeted under Cluster 6.2. The impacts of livelihood enhancing interventions on ecosystem service delivery across spatial and temporal scales will be assessed. The impacts impact of alternative natural resource management systems and governance frameworks on livelihoods, differentiated by gender and social status will also be studied. Trade-off analyses will seek to identify optimum strategies for implementation at both household and landscape scales with an emphasis on promising co-benefits of harmonizing technological and institutional interventions. Collaborations with WLSE, PIM and the external global initiative on the Economics of Land Degradation (http://eld-initiative.org/) are being initiated to assess costs and benefits at larger scales (off-site effects).

**The cluster outputs will be:**

- Landscape scale impacts of complex livelihood options on resilience, poverty, equity, and nutrition identified taking into account ecosystem services.
- Improved understanding of the social-ecological factors strongly affecting livelihood system impacts in drylands.
- Awareness created amongst key stakeholders for trade-offs and synergies at scale related to alternative livelihood strategies.
- Critical governance challenges related to multiple outcomes of complex dryland livelihood systems identified.
- Options identified to strengthen formal and informal institutions (including land tenure) and social capital, especially for women, smallholders and youth for equitable and sustainable uses of natural resources.
- Institutional and management options assessed that make food production water and energy efficient and preserve biodiversity.
- Technological and institutional options identified to more effectively integrate trees, crops and livestock for reduced environmental impacts and increased agro-biodiversity of agricultural systems (including CPRs).

**CoA 6.4 ENABLING ENVIRONMENTS FOR WIDESPREAD ADOPTION**

**Outcome delivered:** Development partners implement programs with increased adoption rates of improved livelihood strategies.

This cluster builds strongly on the work of clusters 6.1 to 6.3. It acknowledges that co-production of new solutions is essential for the identification of powerful innovations. Effective and efficient up- and out-scaling of innovative sustainable intensification and diversification options requires, however, less facilitation intensive approaches to be feasible. At the same time, the adoption of any innovation depends on an array of factors not all of them intrinsic to that innovation. Informed by an options-by-context approach, the main tasks of this cluster will be rigorous analysis of contextual factors to predict under which system conditions which innovations are most likely adopted and how enabling environments for adoption might be strengthened.

A review of cases of successful and failed innovation adoption, building on the past experience of the DC, DL and DS CRPs and beyond and taking the social-ecological system context into account will be conducted. This will be used to develop and test a systems framework for the adoption of agricultural and associated innovations at the household and community / landscape scales. This analysis can be linked to the EOI on ‘**Socio-ecological Informatics Platform for Global Agri-food Systems Sustainability**’ submitted by ICARDA and CIMMYT that aims to operate across the CGIAR. There is potential to integrate this activity closely with Flagship 4 via the innovations that will be promoted there. Hypotheses regarding the influence of system features on innovation adoption will be developed and tested using a combination of methods (qualitative research, surveys, experiments, modeling). The information generated will be used to pilot and evaluate alternative processes and organizational
arrangements (e.g. farmer-to-farmer, partner-driven, digital knowledge delivery) for up- and out-scaling approaches in different system contexts.

The cluster outputs will be:

- Gender differentiated behavioral, social, and ecological system variables identified that strongly affect adoption of innovations;
- Costs benefit analyses of up- and out-scaling of different innovations estimated depending on the system context;
- Government and non-government implementing agencies engaged in discussing synergies and trade-offs amongst alternative up- and out-scaling approaches;
- Up- and out-scaling approaches that have been tested in cooperation with government and non-government implementing agencies in different system contexts and their impact was assessed.

CoA 6.5 MULTILAYER INSTITUTIONAL ENVIRONMENTS

Outcome delivered: Governance mechanisms are revised and harmonized in a way that encourages improved livelihood strategies that are adapted to various dryland contexts

The improved knowledge of livelihood systems, interactions between livelihood components, identification of sustainable intensification/diversification options, and adoption conditions can form the basis for institutional change at various scales. Institutions can provide incentives and dis-incentives impacting upon key system features that enable or constrain the proliferation of innovative livelihood strategies. This cluster focuses on institutions and the broader enabling environment for beneficial change. It will identify governance mechanisms that support the adoption of innovations by different social groups in order to improve welfare, resilience and equity.

A broad assessment of community norms and rules, customary and statutory laws and policies affecting livelihood strategies in different social-ecological contexts will underpin the research undertaken by this cluster. This will include assessments of social dilemmas resulting in governance challenges related to alternative livelihood strategies and wider interactions amongst institutions across scales, domains and sectors. This enhanced knowledge will support the development of approaches for analyzing and facilitating context specific institutional and policy innovations supporting improved livelihood strategies.

The cluster outputs will be:

- Analytical decision support tools developed for analyzing governance challenges and institutional frameworks related to integrated livelihood strategies;
- Governance challenges in the integration of components of diverse dryland livelihood systems identified;
- The institutional frameworks enabling and constraining innovative approaches for intensification and diversification of livelihood strategies are identified in different social-ecological systems;
- Interactions between community norms and rules, customary and statutory laws and policies related to different sectors are well understood in different social-ecological system; Approaches and tools are handed over to government and non-government implementing agencies and policy makers supporting context specific institutional change towards innovative livelihood strategies;
- Innovative governance approaches supporting innovative integrated livelihood strategies are discussed with government and non-government implementing agencies and policy makers;
- Innovative governance approaches supporting innovative integrated livelihood strategies are tested in cooperation with government and non-government implementing agencies.
GEOGRAPHIES AND BENEFICIARIES

Flagship 6 will implement its activities in a coordinated manner – with the flexibility to adapt to location-specific considerations – across DCLAS countries. This will allow us to make informative cross-country and cross-regional comparisons (of potential value in delivering our outcomes under Cluster 6.5). This approach will also enhance the contribution that the flagship will make to the delivery of key sub-IDOs at the system portfolio level. During full proposal development, we will consider the benefits of implementing at a number of multi-country sites (transects or clusters) to further enhance our capacity to make cross-country comparisons and to study transboundary issues.

Our current shortlist of implementation sites is as follows:

<table>
<thead>
<tr>
<th>Target countries / clusters / transects</th>
<th>Total population</th>
<th>Rural population (% total population)</th>
<th>Rural poverty headcount ratio at national poverty lines (% of rural population)</th>
<th>Malnutrition prevalence, weight for age (% of children under 5)</th>
<th>Agricultura l land area (ha x 1000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nigeria (5 states)</td>
<td>178,516,904</td>
<td>53.0</td>
<td>52.8</td>
<td>26.7</td>
<td>72,000</td>
</tr>
<tr>
<td>Ethiopia (2 regions)</td>
<td>96,506,031</td>
<td>81.0</td>
<td>30.4</td>
<td>25.2</td>
<td>100,000</td>
</tr>
<tr>
<td>India (3 states)</td>
<td>1,267,401,849</td>
<td>67.6</td>
<td>25.7</td>
<td>43.5</td>
<td>179,300</td>
</tr>
<tr>
<td>Ghana/BurkinaFaso/Mali transect</td>
<td>59,630,020</td>
<td>57.9</td>
<td>41.5</td>
<td>9.7</td>
<td>54,574</td>
</tr>
<tr>
<td>Zimbabwe/Zambia/Mozambique transect</td>
<td>56,100,304</td>
<td>63.6</td>
<td>60.0</td>
<td>34.4</td>
<td>85,708</td>
</tr>
<tr>
<td>Morocco (hub for North Africa)</td>
<td>33,000,000</td>
<td>41.9</td>
<td>15.0</td>
<td>5.6</td>
<td>45,770</td>
</tr>
<tr>
<td>Uzbekistan (hub for Central Asia)</td>
<td>29,324,920</td>
<td>63.0</td>
<td>36</td>
<td>23.0</td>
<td>27,325</td>
</tr>
</tbody>
</table>

The target beneficiaries will be rural small holder farmers including women and youth. Women because they manage up to 90% of staple food production and as only 15% of agricultural advisers are women and only 5% of advice reaches women, will receive particular attention. Similarly drylands have the highest rates of youth unemployment reaching over 25% in young males and more than 40% in females in the Middle East for example (http://drylandsystems.cgiar.org/sites/default/files/YouthStrategy.pdf).

GENDER INTEGRATION

Flagship 6 aims to make a decisive contribution to the improvement of rural livelihoods through inter alia, increasing resilience in the face of climate change, more food, income and options through diversification, intensification and value addition. It proposes to include interacting decision-making, incentives and innovation processes in agriculture that depend on tacit and intangible norms and values relating to the social roles of men and women in an agricultural livelihood system, and on the web of relations between social roles and actors within the system. To research these interrelations gender-differentiated interdisciplinary research is required.

The research will include ex ante gender-differentiated impact assessment using complementary gender-responsive system modeling, gender-differentiated household portfolios of activities and management practices of resources and biodiversity, the identification of options for female and male stakeholders to improve formal and informal institutions such as land tenure, the division of labour and decision making on use of income and social roles pertaining to gender and age. This will help better target development interventions in agricultural livelihood systems to ensure equitable access of women and men to options, resources and benefits in order to
achieve a lasting and sustainable reduction of poverty and increase in food and nutrition security, health and social wellbeing.

**PARTNERSHIPS**

<table>
<thead>
<tr>
<th>Partner type</th>
<th>Partner organisation</th>
<th>Role in flagship</th>
</tr>
</thead>
<tbody>
<tr>
<td>CGIAR</td>
<td>ILRI, ICARDA, ICRAF,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ICRI, Bioversity, IWM</td>
<td>Flagship and cluster research leadership. Lead design and establishment of research designs and protocols in collaboration with partners.</td>
</tr>
<tr>
<td>NARS</td>
<td>INRA, Morocco</td>
<td>Testing of system options</td>
</tr>
<tr>
<td>ALI / ARI</td>
<td>WUR, CSIRO</td>
<td>Collaborating in <em>ex ante</em> impact assessments.</td>
</tr>
<tr>
<td>Development partner</td>
<td>CRS, GIZ</td>
<td>Collaborate in piloting and capacity development activities.</td>
</tr>
<tr>
<td>Co-investment partner</td>
<td>AGP (Ethiopia)</td>
<td>Underwrite collaborative scaling initiatives arising out of DCLAS research. Contribute to the justification in economic terms of the suggested interventions and a strategy for scaling out; developing linkages with the private sector.</td>
</tr>
</tbody>
</table>

**FLAGSHIP THEORY OF CHANGE & IMPACT PATHWAY**

The Impact Pathway and Theory of Change for Flagship 6 are presented in FP6_Annex 1 and 2

*CVs of writing team members are presented in Annex 15.*
FP6_Annex 1. Theory of Change and Impact Pathway
IMPROVED RURAL LIVELIHOOD SYSTEMS

CoA 6.1: System-specific ex-ante analysis and prioritization
FTL-AFS WLE

FP1: Priority Setting and Impact Acceleration

FP3: Variety and Hybrid Development

CoA 6.2: Testing, adaptation and validation of options

Tested and validated options adapted by farmers
1.1.2 1.3.2 1.3.3 1.4.2 6.1.1 3.3.3 2.1.2

CoA 6.3: Implications of scaling across landscapes
FTL-AFS WLE

Strategies for mitigation of negative impacts at scale
3.1.3 3.2.2 3.2.3 A.1.4 A.1.1

CoA 6.4: Enabling environments for widespread adoption

Development partners implement programs with increased adoption rates C.1.1 D.1.4

CoA 6.5: Wider institutional environments

Governance mechanisms are revised and harmonized D.1.1 C.1.3 1.1.2

Strategies adapted for improved livelihoods in drylands

Key
Enablers | Output/outcome | Cross CRP linkage | Sub-IDO code | CoA# | Intermediary outputs | Assumptions

RESEARCH FRAMEWORK

Joint Activities
Other AFS, CCAFS, WLE, PIM

Enabling Environment
Strengthening local institutions, policy advocacy, support from regional org

Research Activities
Research Outputs

Research Activities
Research Outputs

Joint Activities
FP1; FP2, 3 and 4; FP5 and FS7

Development Partners
Co-investment in scaling (CCAFS, WLE, PIM)

Sub-IDOs | IDOs | SIDs

System-wide
FP6_Annex 2. The flagship theory of change links the flagship outcomes – resulting from the delivery of its research outputs – to the system level sub-IDOs

<table>
<thead>
<tr>
<th>Cluster outcome</th>
<th>Enabling environment</th>
<th>Risks and assumptions</th>
<th>Contributing to key sub-IDOs</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.1. Farmers offered more effective livelihood options for systems intensification, diversification and resilience.</td>
<td>Existing datasets and research outputs relating to intensification, diversification and resilience. Outputs generated by FP1. R4D community of existing and new partnerships. Synergies with other CRPs (Livestock, WLSE, FTE). Demand from client farmers for technologies for intensification, diversification and resilience.</td>
<td>Baseline data are available that can be used to accurately characterize and stratify target livelihood systems. Models can be developed or adapted to generate robust ex ante impact assessments for the target systems. Research teams (within and beyond DCLAS) and development partners can work together to engage potential beneficiary farmers for piloting. Resource mobilization is adequate to support required inputs.</td>
<td>This is an enabling cluster that will improve targeting of the research to be implemented by other FP6 clusters and flagships to directly target specific IDOs.</td>
</tr>
<tr>
<td>6.2. Tested, adapted and validated options applied for SI and livelihood diversification applied by farmers.</td>
<td>Existing field sites and associated partnerships of DC, GL and DS. Outputs generated by FP1, FP3, FP6 and Cluster 6.1. Synergies with other CRPs (Livestock, WLSE, FTE), where co-located.</td>
<td>1.1.2. Reduced production risk. 1.3.2. Increased livelihood opportunities. 1.3.4. More efficient use of inputs. 1.4.2. Closed yield gaps through improved agronomic and animal husbandry practices. 2.1.1. / 2.1.2. Increased availability of / access to diverse nutrient-rich foods 3.3.3. Enhanced adaptive capacity to climate risks. B.1.1. Gender-equitable control of productive assets and resources. B.1.2. Technologies that reduce women’s labor and energy expenditure developed and disseminated.</td>
<td></td>
</tr>
<tr>
<td>6.3. Strategies (portfolio revision, governance options) for mitigation of</td>
<td>Existing field sites and associated partnerships of DC, GL and DS.</td>
<td>3.1.3. Increased genetic diversity of agricultural and associated landscapes.</td>
<td></td>
</tr>
<tr>
<td>Negative Impacts at Scale Validated and Applied.</td>
<td>Outputs generated by FP1, FP4 and Cluster 6.1. Synergies with other CRPs (Livestock, WLSE, FTE), where co-located.</td>
<td>3.2.2. Agricultural systems diversified and intensified in ways that protect soils and water. 3.2.3. Enrichment of plant and animal biodiversity for multiple goods and services. A.1.1. Reduced net GHG emissions from agriculture, forests and others forms of land use. A.1.4. Enhanced capacity to deal with climate extremes.</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>6.4. Development Partners Implement Programs with Increased Adoption Rates of Improved Livelihood Strategies.</td>
<td>This outcome strongly benefits from the multiple affordeds undertaken by various development agents. They have the mandate and the resources to indeed effectively scale up and out innovative livelihood system approaches.</td>
<td>Good timing is required between the development of solutions and the uptake by partners. Further, partners need to accept proposed solutions. Early and continuous collaboration is needed in order to ensure that partners create ownership for the results and dedicate resources. C.1.1. Increased capacity of beneficiaries to adopt research outputs. D.1.4. Increased capacity for innovation in partner development organizations and in poor and vulnerable communities.</td>
<td></td>
</tr>
<tr>
<td>6.5. Governance Mechanisms Are Revised and Harmonized in a Way That Encourages Improved Livelihood Strategies That Are Adapted to Various Dryland Contexts.</td>
<td>The very positive reputation of the CGIAR creates trust amongst different policy makers and providers of institutional services into the work of the team. In particular the national program partners will be very critical for gaining a good understanding of the governance framework.</td>
<td>Institutional change does only exceptionally lead to win-win situations. There is always the risk that powerful players oppose institutional changes even if changes were at the benefit of the overall society. In other cases selected groups manipulate the change process towards their interests at the cost of others. A very thorough understanding of the social-ecological system is needed before intervening in complex institutional structures. 1.1.2. Reduced Market Barriers. C.1.3. Conducive agricultural policy environment. D.1.1. Enhanced institutional capacity of partner research organizations.</td>
<td></td>
</tr>
</tbody>
</table>
### FP6 Annex 3. FP6 Linkages to other FPs

<table>
<thead>
<tr>
<th>Cluster of Activities</th>
<th>Collaborating FP</th>
<th>FS5 role</th>
<th>Collaborating FS role</th>
<th>Outputs; Added value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Household livelihood analysis</td>
<td>FP1</td>
<td>Define an indicator framework and identify specific indicators; Design a common socio-ecological sampling frame</td>
<td>Socioeconomic baselines, indicators</td>
<td>Multi-scale characterization of the context in which target systems operate</td>
</tr>
<tr>
<td>Integrated systems analysis, assessment, and modeling</td>
<td>FP1, 2, 3</td>
<td>Application of models across typologies to strengthen foresight studies</td>
<td>Priority Setting</td>
<td>Multi-scale evaluation of promising options</td>
</tr>
<tr>
<td>Scaling of sustainable intensification and diversification options</td>
<td>FP1</td>
<td>Piloting up- and out-scaling approaches; evaluating influence of system features on innovation adoption</td>
<td>Adoption tracking and impact assessment; best-practice dissemination mechanisms</td>
<td>Integrated theoretical and practical assessments of scaling processes and outcomes</td>
</tr>
<tr>
<td></td>
<td>FP4</td>
<td>Evaluation of the influence of system features on innovation adoption</td>
<td>Scaling out seed and technologies</td>
<td>Seed scaling informed by wider lessons about scaling opportunities and constraints</td>
</tr>
<tr>
<td>Institutional innovations, governance and enabling policies</td>
<td>FP4</td>
<td>Assessments of interactions between institutions across scales, domains and sectors</td>
<td>Research on seed systems</td>
<td>Seed systems research embedded in wider input supply context</td>
</tr>
<tr>
<td>Co-production of sustainable intensification and diversification options</td>
<td>FP1</td>
<td>Complementary innovations that are required in the enabling environment to facilitate innovation and adoption</td>
<td>Value chains, demand and constraints</td>
<td>Complementary perspective on the role of markets in the enabling environment for intensification / diversification.</td>
</tr>
<tr>
<td></td>
<td>FP1</td>
<td>Effective integrated, adapted and validated interventions in existing productions systems</td>
<td>Impact analysis and strategies for adaptation</td>
<td>Multi-scale evaluation of promising options</td>
</tr>
<tr>
<td>FP5</td>
<td>Effective integrated, adapted and validated interventions in existing productions systems</td>
<td>Cropping pattern and sequence; Integrated soil-crop-water-nutrient management; mechanization of farm operations</td>
<td>Household intensification / diversification options tested in the context of wider landscape scale issues</td>
<td></td>
</tr>
<tr>
<td>-----</td>
<td>---------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>FP7</td>
<td>Complementary innovations that are required in the enabling environment to facilitate innovation and adoption</td>
<td>Post-harvest value addition techniques, strategies and related policies</td>
<td>Integrated view of the contributions of production and post-production losses to farm gate productivity</td>
<td></td>
</tr>
</tbody>
</table>
FLAGSHIP 7: POST-HARVEST VALUE ADDITION & OUTPUT MARKETS

RATIONALE
Transition from a commodity-based approach to an integrated agrifood system-based approach opens up opportunities, anchored on the component commodity crops of the program, for value-chain diversification and optimization. This in turn will lead to improved livelihoods through increased income, and food and nutrition security. The component crops of the program serve the food, feed and fodder needs of the primarily subsistence-farming populations in our target countries, where mixed crop-livestock farming systems are central to family food and income. Existing awareness or dawning recognition of the protein- and micronutrient-dense nature of the component crops, and newly emerging end uses, such as biofuels, breweries, malting and nutraceuticals, lead to increasing opportunities for the development of output markets and value chains for employment and income generation especially for small holder framers. While the scope for this flagship is vast, we will focus our internal efforts primarily on the development of nutrition-rich, efficient and inclusive value chains, while contributing to existing regional public and private efforts that address the optimization and upscaling of technologies based on the end-uses of the component crops of the program. Approaches to reduce post-harvest (PH) losses and support of the development of nutrient-rich products along with efficient markets lead to the food and nutrition security in our target regions and beyond. According to FAO and the World Bank, about 1.3 billion tons of food per year, which constitute one-third of the food produced globally is lost or wasted in a world where 870 millions of people are suffering from hunger (FAO-World Bank, 2010). At the same time, the United Nations Food and Agriculture Organization estimates that about 805 million people of the 7.3 billion people in the world, or one in nine, were suffering from chronic undernourishment in 2012-2014. These therefore call for the need to reduce post-harvest losses and improve the benefits that people obtain from participating in the value chain of dryland cereals and legumes thereby improving their food and nutritional security.

The objective of flagship 7 (FP7) is to improve income, food and nutrition security in Africa and Asia through reduction of postharvest losses, enhancing market efficiency and linkages, and out-scaling and commercialization, for dryland cereals and grain legumes. This will help fight malnutrition and hunger in Africa and Asia and create opportunities for employment and increase the incomes of farmers and other value-chain actors. FP7 will focus on improved technology and knowledge for processors (CoA 7.1); reduced post-harvest losses through handling and storage (CoA 7.2); increased income through the production and marketing of diversity for food, feed, and fodder (CoA 7.3); increased income through best-fit options/strategies to link different stakeholders to markets with a deliberate focus on women and youth (CoA 7.4), developed/supported business incubation platforms (CoA 7.5) and enabling environments to link stakeholders to markets (CoA 7.6).

A value chain approach, involving all key stakeholders, that brings financial benefit to the smallholder farmers by maximising the utilisation of their produce through efficient and inclusive post-harvest interventions will be necessary to deliver on the System-Level Outcomes to promote food, income and nutritional security, and to the associated grand challenges. Interventions for post-harvest loss reduction are critical to food security, especially in the target regions where the extreme climate resilience of most of the component crops of the program make them reliable sources of food, feed and fodder. In addition, tapping into the unique nutritional potential of these crops within DCLAS, and addressing their potential for income generation specifically within this flagship, allow significant contributions to nutritional and income security.

Inefficiencies and the distortions of output markets for these crops are as important as the PH loss emphasised here. Through identifying and piloting innovative institutions, the flagship intends to develop innovative institutional arrangements that will enhance market participation. These will include marketing associations of common-interest groups that are independent, flexible, and informal groups of farmers focusing entirely on marketing of the component crops. Such common-interest and indigenous-institution based associations will increase market participation through, among others, collective decision making and sharing of production and marketing information that will eventually result in stronger bargaining power among smallholder value chain actors. There is also a gap in access to relevant and timely market information. This has resulted in high transaction cost for smallholder farmers in particular. There is a challenge in accessing rewarding markets as rural farm households lack
information on the price patterns across markets. Provision of information on the level of markets integration and patterns of price volatility would enable value-chain actors to make informed marketing decisions. This would also inform the policy making process vis-à-vis the challenges the value chain actors face and have a significant contribution to the policy and investment environment. The Flagship 7 of DCLAS addresses the grand challenges in regard to nutritious and diverse agri-food systems and diets; post-harvest losses; food safety, and new entrepreneurial and job opportunities. The major outputs of FP7 are i) improved post-harvest technologies to reduce post-harvest losses in quantity and quality, ii) Novel and diverse dryland cereal-based products to stimulate demand for grain, and iii) institutional innovations to improve linkages between smallholder farmers and markets.

**Issues to be addressed**
The immediate research questions to be addressed by FP7, in specific relevance to the component crops of DCLAS, are:
- What is the extent of post-harvest losses prevailing in the target regions, and what interventions are required in chosen pilot locations to reduce existing post-harvest losses?
- Which low-cost, low-tech and socially acceptable post-harvest technologies are available or can be made available to improve food and nutritional security?
- What value-added food products can create increased marketability for the component crops?
- What processing, packaging, and labor-saving technologies and interventions allow for the development of nutritious and safe food, feed, and fodder products?
- What are the best-fit strategies that can be put in place in order to increase the marketing of DCLAS products?
- How can the private sector collaborate in the development of the value chains and how can we effectively upscale the learning and experiences of pilots?
- What entrepreneurship development platform should be established in order to ensure effective output market linkages, out scaling and commercialization of products from the component crops in a sustainable manner?

**Comparative advantage**
In collaboration with A4NH, Dryland Cereals and Grain Legume Phase I provided a platform and learning experience for using agriculture as a pathway for contributing to improved nutrition by developing and promoting nutritionally enhanced varieties. We will continue building on this relationship for still further improvements to nutrition security in our target regions. Dryland Cereals CRP and Grain Legume CRP Phase I initiated exploratory research on product development and diversification, and identified that the uptake of products was low due to inadequate consideration for sensory attributes, consumer preferences, availability of competing products, and market potential. Strategies are needed that diversify food, feed, and fodder with synergistic impacts on nutrition, employment and income. Value-chain analysis during Phase I showed an upward trend in area, yield and production of grain legumes, mainly driven by increasing end-market demand, and increasing procurement from the farm gate by large scale agribusiness firms. The value chains for dryland cereal and grain legume crops are rapidly evolving in the target countries. The sorghum breweries of Kenya are rapidly enabling transition from subsistence to market-oriented sorghum cultivation. Significant end-market opportunities exist in the increasing unmet demands in urban centres in domestic and regional markets, substitution for imported food and international markets.

**CLUSTERS OF ACTIVITIES (CoA)**
**CoA 7.1: IMPROVED TECHNOLOGY AND KNOWLEDGE FOR SMALL-SCALE PROCESSORS**
Given the willingness and ability to pay, cultural differences and consumer preferences are key drivers for food acceptance. The introduction of new technologies must be done considering the needs and preferences of the target group as well as considering in a holistic way the local processing methods. Traditional methods of processing such as threshing, winnowing, and pounding are not only inefficient but also labor-intensive. Therefore, research will focus on developing/adapting and introducing simple and efficient labor saving devices. In addition, we will introduce/evaluate new or improved traditional processing methods that may result in a product with enhanced nutritional and storage quality. Knowledge regarding processing options exists in some local communities where respective dryland cereals and legumes are grown. However, knowledge about the preparation of such products is
not yet documented and distributed, processing only takes place occasionally on a small-scale, and processing options still need to be optimized, especially in regard to a longer shelf life for these products.

**CoA 7.2: IMPROVED POST-HARVEST HANDLING AND STORAGE**

Significant postharvest loss, up to 50%, has been attributed to the lack of adequate knowledge and implementation of sound grain storage management. In nearly all cases, the lack of data makes it difficult for local authorities and international partners to assess the extent of postharvest loss. In many developing countries, necessary data is not available to credibly estimate the extent of postharvest loss at any phase of production and distribution.

### 7.2.1 Tools and methods for assessing postharvest losses:

Although the main causes of post-harvest losses are known and well documented, it is important to further explore peculiar factors that cause post-harvest losses through the value chain (harvest, de-husking, shelling/threshing, drying, winnowing, storage of raw produce, packing/bagging, transport and loading, processing/milling and storage of processed produce). There is need to explore the interplay/interaction of these causes on points within the value chain of the crops. There are no generally accepted methods for measuring post-harvest losses; standardized methods are needed for rapid and reliable assessment of losses. Information on post-harvest loss issues such as magnitudes, factors influencing loss and management practices is inadequate and outdated, and not comprehensive enough to make any meaningful policy decisions. Thus tools and methods will be developed that can provide post-harvest grain-loss assessment yielding standardized and reproducible results so that effective grain-loss reduction efforts can be undertaken.

### 7.2.2 Storage technologies to reduce post-harvest losses and improve quality of stored grain:

Post-harvest losses occur at different stages such as harvesting, threshing, winnowing, transporting and storage, with storage being the stage at which the biggest loss occurs. The causes of postharvest losses are multiple, however, the most significant losses are caused by pests (insects and rodents), lack of appropriate storage facilities, inappropriate handling and packaging, and inadequate means of transportation. Efforts to reduce post-harvest losses will include assessment of post-harvest losses from insects, rodents, molds, rancidity and other sources, and management to reduce severity in the flagship delivery model. Additionally, during this period we will also deliver management options to reduce these losses. The identified technologies shall be made available to the farming community through private sector intervention by providing them know-how on equipment/machinery for development/fabrication based on local needs. These shall be further popularized for adoption by the farming communities.

**CoA 7.3: DIVERSITY FOR FOOD, FEED AND FODDER FOR INCOME GENERATION AND NUTRITION**

Diets evolve over time, being influenced by many factors and complex interactions. Income, prices, individual preferences and beliefs, cultural traditions, as well as geographical, environmental, social and economic factors all interact in a complex manner to shape dietary consumption patterns (Akibode and Maredia, 2011). Strategic interventions through CoA 7.3 will include: (1) formulation of innovative functional food products, by leveraging the nutritional and functional properties of cereals and legumes, to address the nutritional and health needs of different target consumer segments and market demands; (2) understanding the nutritional (macro and micronutrients), bioactive (antioxidant activities related to polyphenol content, prebiotics etc.), functional (starch and protein digestibility, water and oil absorption capacity etc.), anti-nutritional (phytic acid, saponins, polyphenols, lathyrogens, α-galactosides, protease inhibitors, α amylase inhibitors etc.) aspects of cereal and legume varieties/hybrids, and relating them to sensory properties and consumer preference. In addition, we will determine processing factors that could enhance retention of nutrients and bioavailability and simultaneously reduce anti-nutritional factors. Research will also focus on developing nutritious and novel food products and increased diet diversification.

The dominant use of barley for animal feed is as grain, but its use as green and dry biomass is widely practiced in smallholder agriculture and warrants more R4D than was expressed in the original and extension-phase proposals. Current collaborative work on breeding for dual-purpose (food and feed) varieties of sorghum and millets will be further strengthened and intensified. We will assess how crop fodder can be better used in feeding strategies, how it can be better stored or processed to increase animal nutritional quality, and how improving food, feed, and fodder market efficiency could improve returns to the farmers who produce it. Popular released and advanced pipeline varieties of cereals and legume crops used as animal feed will be characterized for exploitable variations in feed and...
fodder quality in close collaboration with fodder traders and feed processors. Information and findings from FP3 will be synthesized and in combinations with feed and fodder market surveys used to build scenarios for context-specific feed optimization and appropriate information and delivery systems. Smallholder incomes, particularly for women can be significantly enhanced by improving post-harvest and processing technologies. Using legume haulms to provide high quality animal feed and legume seed as an important source of protein and other nutrients for feed rations will be explored.

**CoA 7.4 POLICIES, INSTITUTIONS AND DEVELOPMENT OF OPTIONS/STRATEGIES TO LINK DIFFERENT STAKEHOLDERS TO MARKETS WITH DELIBERATE FOCUS ON WOMEN AND YOUTH**

Studies will be undertaken on regional trade of local crops that will focus on quantifying regional trade flows, identifying and measuring comparative advantage between countries, identifying barriers to trade; and modelling impact of changes in trade policies. Under the area of regional trade, we will assemble available data on official and cross-border trade, conduct regional trade analysis including comparative advantage within the regions, and model the impacts of removing barriers to trade keeping in view smallholder welfare in the target regions. We will also identify specific market scenarios for the product platforms; profile the business opportunity for a particular product in terms of investment and returns for an entrepreneur to start a business around the value chains. We will develop region specific policy advocacy for submission to the concerned government authorities for appropriate policy interventions. For example, markets for grain legumes emphasize different marketable characteristics ranging from a nutritious staple food to imported traditional or exotic food, ready-to-eat snack food to ecologically-efficient protein source, or crops that are resilient and reduce effects of climate change. Research is needed to determine the existing size of markets, efficiency and integration of markets, and potential growth as a result of coordinated advocacy efforts amongst public and private sector organizations. Depending on the context, we will develop strategies for which majority of our target population mainly women and the youth can be linked to local regional and international markets. Some of the strategies that will be considered include collective action for marketing, lead firms, innovation platforms and development of financial options.

**CoA 7.5: BUSINESS INCUBATION PLATFORM FOR ENTREPRENEURSHIP**

Technology development alone cannot lead to economic development unless the technologies are put to economic use by entrepreneurs. The role of the entrepreneur is to organize and put to use capital, labour and technology in the best possible manner for the setting up of his/her enterprise, and to do so, there is a need for support. It is necessary to support a business venture operating around a particular value-chain to make them viable through mentoring and technical backstopping. The products that emerge from existing efforts are broadly classified under breakfast cereal, snacks and weaning food which shall be developed into individual products under these product platforms. Leveraging the experience of the partners, entrepreneurship development will be targeted in one or more regions. The pilot envisions strengthening and/or filling weak and missing links in the value chains in the target regions. It is proposed that an entrepreneurship development platform is implemented in pilot mode in three target countries, leveraging the existing Agribusiness and Innovation Platforms at two of the participating centers, and the South-South collaboration. The business platform will provide the following mentoring services to the start-ups and SMEs in the target countries:

- Technology development & commercialization of target crops with support from the stakeholders and regional NARS partners
- Consultancy on agricultural technology and know-how on process development
- Business consultancy through pre-feasibility studies, market research consultancy, networking with bankers, venture capitalists and markets
- Training on entrepreneurship development, skill upgrading and business management
- Facilitate funding through grant schemes & Govt. programmes, Venture Capital Funds and banks etc.
- Provide infrastructure facilities like office space, labs, pilot facility, testing & trials platform, greenhouse, cold storage etc.
Networking and handholding by facilitating linkages with markets, technology providers, industry experts, government agencies, etc.
The incubator can support the entrepreneurs in agribusiness through its diversified mentoring services that can include business planning, providing R&D infrastructure facilities, prototype development and testing, product validation, business development, facilitating financial assistance through debt and equity.

CoA 7.6: ENABLING ENVIRONMENT TO LINK STAKEHOLDERS TO MARKETS
The introduction of new technologies must be done considering the needs and preferences of the target group as well as considering in a holistic way the local processing methods. By improving the processing technologies and knowledge to medium cereal and legume processors, new commercialization opportunities are open for the producers. By improving the processing technologies and knowledge to small-to-medium maize processors, new commercialization opportunities are open for the producers. Cereal and legume processing into primary and secondary products is dominated by medium scale processors whose challenges include poor market access for their products, in adequate packaging, inefficiency of processing equipment, and poor product quality. Research will focus on analysing the efficiency of processing equipment and technology requirements to meet end-users’ demand for product development (traditional and new products) of medium scale businesses; designing/adapting and disseminating improved and profitable processing equipment developed in each region or available elsewhere for the production of food products for defined markets; in collaboration with regulatory agencies, evaluate different packaging materials and storage for identified food products; formulate product quality standards through low-cost quality assurance systems; enhancing the capacity of medium scale processors within the public and private sectors to promote entrepreneurship, strengthen managerial skills and enhance food product standards and grades. The feasibility and profitability of small-scale mechanization will be evaluated based on experience at field level to assess market demand; linkages will be made with equipment producers to promote adoption. We will also focus on adapting milling fractionation technologies and fermentation to meet the needs of processors and consumers; conducting market studies for identified products; identifying appropriate packaging materials; empowering medium scale processors with sustainable processing technologies and processing knowledge to improve nutritional quality and reduce food losses, and small scale flour and extrusion technologies for development of value added products.

Expected Outcomes and Contributions to CGIAR SRF
Target sub-IDOs include diversified enterprise opportunities; increased livelihood opportunities; reduced pre- and post-harvest losses, including those caused by climate change; increased availability of diverse nutrient rich foods; enhanced capacity to deal with climatic risks and extremes; and technologies that reduce women’ labor and energy expenditure developed and disseminated. Progress towards the sub-IDOs and SLOs will be measured and documented mainly through:
- Number of nutritious food products available
- Number of households consuming nutritious food products
- Number of households using improved postharvest handling and storage technologies
- Number of marketing strategies/options linking processors to markets
- Number of improved/developed processing equipment, especially labor saving devices
- Number of established food standards
- Number of small and medium enterprises (SMEs)
- Number of feed producers and traders selling feed and fodder
- Number of new entrepreneurs trained on business development skills
- Percentage increase in income for actors in DCLAS products

Relation to other Flagship(s)
FP7 is a key and cross-cutting flagship for all CG centres and also most of the public and private-led research for development institutions. Post-harvest value addition and output markets for nutrition decrease the unit cost of nutrients and increase the economic and nutritional value of processed products and make them readily available to the end user. FP7 will primarily work with FP1, FP3 and FP6 to deliver demand-based outputs in the target regions. FP1 will provide information on prevailing needs, end uses and markets at a sub-regional level, which will be used to focus FP3 efforts on the development of varieties and hybrids that meet local end-user demand, which in turn will be the focus of FP7 efforts for value-chain development and/or optimization, and for up-scaling and opportunistic

DCLAS PRE-PROPOSAL

82
out-scaling. FP7 will also collaborate closely with FP6 to upscale successful pilots on livelihood improvement scenarios delivered by FP6.

**GEOGRAPHIES & BENEFICIARIES**

The target countries are selected based on malnutrition prevalence and opportunities for post-harvest technologies improvement. In each country, poor rural people, vulnerable people (youth, women, and children) will be considered. Using participatory approach we will identify how differences between youth men, youth women, women and men can affect decisions in adopting the developed post-harvest technologies. Though the focus will be primarily on the post-harvest and output market but at the same time the partnerships shall play a critical role in delivery of the activities on each of the cluster of activities which shall decide the exact locations of each intervention. These interventions shall involve stakeholder like farmers, input suppliers, service providers, commodity markets and industries. The women and youth shall draw key attention in terms of providing livelihood opportunities based on their competence in the entire value chain.

<table>
<thead>
<tr>
<th>Results or Outcomes</th>
<th>Target IDOs and sub-IDOs</th>
<th>Target Countries</th>
<th>Key assumptions</th>
</tr>
</thead>
</table>
| Households consuming nutritious food products | Increased availability of diverse nutrient rich foods | Nigeria, Ethiopia, India, Ghana/Burkina Faso/Mali transect, Zimbabwe/Zambia/Mozambique transect, Morocco, Uzbekistan | - Adequate awareness for the nutritious food is created  
- Products have consumer desirable quality characteristics |
| Improved/developed processing equipment, especially labor saving devices | Technologies that reduce women labor and energy expenditure | Nigeria, Ethiopia, India, Ghana/Burkina Faso/Mali transect, Zimbabwe/Zambia/Mozambique transect, Morocco, Uzbekistan | - Favorable enabling environment for technology production and adoption  
- NGOs, private sector and NARS willingness to disseminate new ideas |
| Households using improved postharvest handling and storage technologies | Reduced pre- and post-harvest losses, including those caused by climate change | Nigeria, Ethiopia, India, Ghana/Burkina Faso/Mali transect, Zimbabwe/Zambia/Mozambique transect, Morocco, Uzbekistan | - Favorable enabling environment for technology production and adoption  
- NGOs, private sector and NARS willingness to disseminate new ideas |
| Entrepreneurs establish small and medium enterprises (SMEs) | Diversified enterprise opportunities | Nigeria, Ethiopia, India, Ghana/Burkina Faso/Mali transect, Zimbabwe/Zambia/Mozambique transect, Morocco, Uzbekistan | - Target stakeholders are willing to take risk into new enterprises |
| Feed producers and traders selling feed and fodder | Diversified enterprise opportunities | Nigeria, Ethiopia, India, Ghana/Burkina Faso/Mali transect, Zimbabwe/Zambia/Mozambique transect, Morocco, Uzbekistan | - Willingness of actors to engage in new enterprises  
- Consumers/buyers willing to try new formulations  
- Enabling policy environment in terms of food standards and quality management |
| New entrepreneurs trained on business development skills | Increased livelihood opportunities | Nigeria, Ethiopia, India, Ghana/Burkina Faso/Mali transect, Zimbabwe/Zambia/Mozambique transect, Morocco, Uzbekistan | - Women and youth willing to venture into new businesses  
- Willingness and capacity of the trainees to take new knowledge acquired into practice |
| Marketing strategies/options linking processors to markets | Increased livelihood opportunities | Nigeria, Ethiopia, India, Ghana/Burkina Faso/Mali transect, Zimbabwe/Zambia/Mozambique transect, Morocco, Uzbekistan | - Willingness of actors to use new organizational strategies  
- Enabling policy and institutional environment to support various marketing and organizational strategies  
- Strategies flexible to be adaptable to various social and economic conditions  
- NGOs, private sector and NARS willingness to disseminate new ideas |
The target countries are selected based on malnutrition prevalence and opportunities for post-harvest technologies improvement. In each country, poor rural people, vulnerable people (youth, women, and children) will be considered. Using participatory approach we will identify how differences between youth men, youth women, women and men can affect decisions in adopting the developed post-harvest technologies.

**SCIENCE QUALITY**

Innovative approaches and tools will be undertaken using multidisciplinary and inter-institutional approaches. They include:

- Use of high-throughput methodologies and tools for rapid assessment of nutritional and end-use quality of raw materials and linking them to sensory and consumer preferences.
- Development of database on nutrient content of food products consumed in different regions and linking it to processing methods.
- Use of consumer driven product development approach; regional exchange between best practices and uses of target crops among different countries.
- The creation of value and product diversification along the entire production chain, from producers to processors.
- Strategic partnerships with advanced research institutions/universities, food companies and health institutions for product formulation and scale out, and with regulatory agencies for quality standards.
- Design of locally adapted and cost-efficient labor saving technologies and processing equipment.
- Assessment of gender transformative and inclusiveness of value-chain interventions.

**GENDER INTEGRATION**

During Phase 1 the Gender Strategy for Dryland Cereals was developed and will be used to expand the institutional architecture of the integration of gender into FP7. An inventory of gender research to date is currently being developed. From this inventory, we will identify which populations have been targeted in the work of the FP so far, in order to assess the impact of research on the target populations. The inventory will be used to identify other potential population targets like young men or women that may be invisible actors in the dryland-cereals value chain and who could benefit through inclusion and/or innovations. Collection of gender-disaggregated data will be undertaken in the clusters of Activities.

**PARTNERSHIPS**

*Connections with other CRPs:* FPS will work within a sub-selection of the agri-food systems where partnerships with other Agri-food systems CRPs have already been established by FP6, and especially with the agri-food system on Livestock given that the combination of dryland cereals, grain legumes and livestock is the backbone of several traditional farming systems. Docking of activities with Livestock/ILRI will be essential for the use of cereal, legumes and their by-products for animal feed. Strong partnership with the efficient and inclusive value chain flagship of policy, institutions and markets CRP is expected as well. Other opportunities exist in the shared approaches to processing and storage options (e.g. with MAIZE).

*Non-CGIAR Partners:* Externally, FP7 will identify and select non CGIAR partners based on gaps in competencies and experiences within the FP. These partners will be contacted and will be invited to express their interest in contributing to the overall objective of FP7. Partner for grain legumes include UC Davis (post-harvest) and UC Riverside (cowpea), Kansas State University (Department of Grain Science and Technology). Other partners might include CIRAD, FAO, University of Pretoria, South Africa, ITI Colombo, Sri Lanka, Private Sector Food Processing Industries etc.

*Docking with Integrating Programs:* Nutrition is a multi-sectoral challenge. Collaborative work with A4NH in Phase I have been focused on development and promotion of biofortified crops and food safety through research focusing on reduction of aflatoxin contamination of groundnut in SSA. During Phase II, FP7 will develop stronger collaboration with A4NH and PIM for the tools and methods, adoption and dissemination of the biofortified and other nutritious safe food products, approaches and lessons to be learned on diet changes.

**CAPACITY DEVELOPMENT**
Capacity building efforts will be scaled up from the level in Phase 1, and the scope of short-term training sessions will be enhanced to cover the various parts of the value chain for dryland cereals and legumes, but with renewed emphasis on newer tools and technologies for post-harvest value addition and output markets. In addition, efforts will be made with emphasis on increasing the participation of women and other under-represented minorities in capacity development programs. Capacity development will focus on:

- National and international postgraduate students and post-doctoral fellows will be trained
- Regular workshops with actors in the agricultural value chains to disseminate efficient post-harvest technologies reducing losses and enhancing the nutritive quality of the food
- Training materials will be designed in collaboration to facilitate knowledge transfer within members of the involved institutions and other DCLAS partners: short courses, summer schools, curricula development of full programs.
- Installation and monitoring of the innovation platforms where actors in the value chains will share knowledge

**FLAGSHIP THEORY OF CHANGE & IMPACT PATHWAY**

The Impact Pathway and Theory of Change for Flagship 7 are presented in FP7_Annex 1.
Assumptions

A1: New technologies are sustainable; widely accepted by communities; and enhance value of the commodities

A2: Dryland cereals based product are uniquely positioned in the market as nutrition rich product options.

A3: Customised feed products will have better acceptance over traditional formulations/products

A4: Partners’ capacity is built and partners are able to play the critical role.

A5: Partnership linkages leverage readily available technologies and research outputs to expedite large scale product development

A6: Appropriate policies and strategies developed and implemented creating an enabling environment for growth of entrepreneurship/partnership with large scale industries focused on the DCLAS crop value-chain

FP7_Annex 2. FP7 Linkages to other FPs
The objective of flagship 7 (FP7) is to improve food and nutrition security in Africa and Asia through smart post-harvest value addition and marketing of dryland cereals. The following table shows collaborating Flagships (FPs) within each cluster of activity on FP7 and their role in the collaboration.

<table>
<thead>
<tr>
<th>Cluster of Activities</th>
<th>Collaborating FP</th>
<th>FS6 role</th>
<th>Collaborating FS role</th>
<th>Outputs; Added value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Develop diverse novel and nutritious dryland cereal and legume food products</td>
<td>FP2,3</td>
<td>- Relate consumer preferences to sensory and physicochemical properties of dryland cereal and legume grains</td>
<td>FP2 will assist in identifying nutritionally enhance and genetically diverse germplasms since CoA in FP3 include varietal development and multiplication trials</td>
<td>- Nutritionally enhanced and genetically diverse germplasms, and on linking genetics with sensorial and processing quality identified - varietal and processing factors that might enhance the retention and bioavailability of useful nutrients and simultaneously reduce the anti-nutrients in cereals and legumes determined -value-added dryland cereal and legume products developed</td>
</tr>
<tr>
<td>Improved technology and knowledge for small-to-medium-scale processors</td>
<td>FP1, FP4</td>
<td>- Optimization of small and medium scale processing (SMEs) systems for dryland cereal and legume grains</td>
<td>FP1 will provide FS7 with drivers of adoption of best practices. This will help develop appropriate processing technology and knowledge methods</td>
<td>- small and medium scale processing (SMEs) systems for dryland cereal and legume grains optimized - processing methods for enhanced product nutritional and storage quality, greater labor productivity, and income generation optimized</td>
</tr>
<tr>
<td>Use of dryland cereal and legume grains and by-products for animal feed</td>
<td>FP6</td>
<td>- Enhancing dual-purpose use of dryland cereal and legume grains and their by-products</td>
<td>FP6 will provide FP7 with livestock management methods at household level</td>
<td>- dual-purpose use of dryland cereal and legume grains and their by-products improved - innovative and affordable animal feed formulations that can generate income and impacts developed</td>
</tr>
<tr>
<td>Reduce post-harvest losses through improved</td>
<td>FP1, FP4</td>
<td>- Reduction of post-harvest losses</td>
<td>FP1 will provide FS6 with factors that might induce post-harvest losses</td>
<td>Post-harvest methods reducing losses by actors in the value chains improved/developed</td>
</tr>
<tr>
<td><strong>storage technologies</strong></td>
<td></td>
<td><strong>FP4</strong> will provide FP7 with factors influencing seeds conservation after harvesting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------------------</td>
<td>-------------------------</td>
<td>--------------------------------------------------------------------------------</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| **Value chain analysis, market development, and policies** | FP1, FP6 | - Identify ‘best-bet’ value chains that have high growth potential and the potential to raise incomes for poorer smallholders  
- Identify the product lines and product portfolio for the flagship to enter into the value-chains and scale-up options  
- Quantify regional trade flows, identifying and measuring comparative advantage between countries, identifying barriers to trade; and modelling impact of changes in trade policies  
- Identify prevailing market scenarios for the product platforms, profile the business opportunity for a particular product segment in terms of investment and returns for an entrepreneur to start a business around the value chain  
- Develop region specific policy advocacy for submission to the concerned government authorities for appropriate policy interventions |
| | **FP1** will participate in Value chains analysis, demand and constraints  
**FP6will provide FP7 with institutional innovations governance and enabling policies** | - ‘Best-bet’ value chains that have high growth potential and the potential to raise incomes for poorer smallholders identified  
- Product lines and product portfolio for the flagship to enter into the value-chains and scale-up options identified  
- Regional trade flows quantified; Comparative advantage between countries, barriers to trade studied; Impact of changes in trade policies assessed.  
- Prevailing market scenarios for the product platforms, profile the business opportunity for a particular product segment in terms of investment and returns for an entrepreneur to start a business around the value chain identified  
- Region specific policy advocacy for submission to the concerned government authorities for appropriate policy interventions developed |

<table>
<thead>
<tr>
<th><strong>Out scaling of adapted and</strong></th>
<th>FP1</th>
<th>- Identify business platform in the target</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>FP1</strong> will provide information on</td>
<td>- Business platform in the target country identified; support to the</td>
</tr>
<tr>
<td>Efficient post-harvest techniques and value technologies</td>
<td>country and provide support to the start-ups and small and medium enterprises (SMEs) in the target crops and products in addressing the market needs and popularization of the local crops.</td>
<td></td>
</tr>
<tr>
<td>--------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>- Support entrepreneurs in agribusiness through its diversified mentoring services that can include business planning, providing R&amp;D infrastructure facilities, prototype development and testing, product validation, business development, facilitating financial assistance through debt and equity.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drivers of adoption and best practices dissemination mechanisms</td>
<td>start-ups and small and medium enterprises (SMEs) in the target crops and products in addressing the market needs and popularization of the local crops.</td>
<td></td>
</tr>
<tr>
<td>- Improvement of agribusiness environment for entrepreneurs</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Gender Research in DCLAS AFS CRP

Summary of key gender issues in the drylands farming systems
DCLAS AFS CRP is focused on improving the livelihoods in the dryland regions of Africa, Asia and Latin America through demand driven innovations centered on dryland cereals, grain legumes and livestock and interfacing with the ecosystem. Gender issues that are of concerns in these systems are:

Equitable access to agricultural knowledge and resources
Equitable access to agricultural knowledge and resource that support profitable agricultural production in the drylands [land, time-labour, capital, networks]. Access to knowledge in dealing with biotic and abiotic constraints as well as new ways of engaging with the market is a fundamental lever for initiating change in drylands agriculture. Access to resources that support the application of knowledge push the frontiers of production to a level that leads food security, better nutrition as well as environmental sustainability. According to the FAO [2011], a concerted effort to tackle gender differences in agriculture, by giving women farmers the same resources as men farmers, could lead to increase in agricultural output in the developing world by 2.5-4%. This would result in 100 million more people living above the poverty line. Women make up 70-90% of labour providers in dryland farming systems. Women are the custodians of dryland cereals and legumes seeds and management practices especially in locations where private seed companies do not engage because of low returns to investment. Women’s role in management of natural resources and biodiversity is also critical. DCLAS therefore prioritizes activities that tackle women related constraints in access to knowledge and other types of resources. Time is especially an important resource for women because of the triple burden of labour requirement [productive, reproductive and community roles]. Technologies that tackle drudgery and save labour for women are prioritized in DCLAS. Access to capital remains difficult for farmers overall, and women in farming in particular as well as equity in decision-making over source of income and use of capital within households. DCLAS will therefore prioritize research on especially systems trade-offs and synergies to promote equitable access to knowledge and other resources.

Opportunity and ability to engage with markets
Markets have the potential of creating income for producers of dryland cereals and legumes, and act as distribution mechanism of nutritious food to urban areas. While commercialization of value chains is viewed as a pathway for empowerment and development of drylands communities, there is concern that there are factors that lead to women being unable to participate and benefit from commercial value chains. The dominant narrative sees commercialization as a zero-sum game where men or women struggle for autonomous control. Women groundnut growers in Malawi and Zambia saw commercialization as a non-zero sum game in which greater cooperation between men and women could benefit the household as a whole based on cooperation rather than conflict. With this experience, DCLAS prioritizes understanding the processes of commercialization of value chains and access to market that lead to gainful engagement of women. Understanding women’s definition of empowerment, the involvement of men in this, and the trajectories it takes in different livelihood-systems, and how these lessons can be formulated to bring effectiveness and efficiency to the commercialization of value chains in then drylands is of priority for DCLAS. We focus on women due to evidence-based-correlations that [i] what is good for women ultimately benefits children and the society; with benefits amplified across families and generations [ii] Connecting to the needs and perspectives of women is a scaling up/out strategy in itself [iii] developing value chains and supporting gender equity are mutually supportive goals.

---


DCLAS PRE-PROPOSAL
Who will grow food in the drylands in the future
The average age of the rural farming community, including in the drylands, is rising\(^{10}\). The farmers among the rural youth will shape the future of food production. With a growing population, decreasing agricultural productivity in combination with rural exodus [of the youth] sustainable food production and supply are threatened. The importance of rural youth in addressing the challenge of current and future food production and supply in the drylands can’t be over-emphasized\(^{11}\). Identifying aspirations of female and male youth and responding to them with creating opportunities in the agricultural sector is therefore an area of priority in DCLAS’s research. The unique role that ICT can play in enhancing youth engagement in agriculture is a particular focus; global debate on Youth Agenda and processes of policy formulation, institutional arrangements that support youth engagement in dryland’s agriculture is a priority area to which DCLAS is positioned to contribute to.

Better nutrition for all in the drylands
Dryland cereals and legumes have for a long time been branded the ‘poor man’s food/meat’. This negative publicity caused the nutrient rich foods not to be appreciated in household nutrition contribution; some households grow and sell the cereals and legumes but don’t eat. The nutrition value of the sorghums and millets as well as the grain legumes has been established and documented. The high values of iron and calcium have made the sorghums and millets a ‘wonder food’ for weaning children and managing the diets for the elderly. The benefit of sorghums and millets however traverses all age groups. DCLAS prioritizes enhancing nutrition information and good diet constitution practices focusing on the first 1000 days of life as well as women of reproductive age.

GENDER RESEARCH PRIORITIES FOR DCLAS AFS CRP
Understanding the communities, who are the DCLAS clients, is an important step in contributing to the gender analysis for priority setting. Not all members of a community in a similar geographical area face the same challenges. Some of the inequalities are linked to the social relations systems that allocate different levels of power and privileges to different members of households or to different sectors of the community. Since these relations differ from culture to culture, a CRP like DCLAS that operates in varied cultures and geographical locations in Asia and Africa has a challenge to be intentional in understanding these dynamics and how they affect intervention areas. Although the CRPs forming DCLAS have strong strategies for gender research, the typology analysis has not be completed in a comprehensive way. DCLAS therefore prioritizes Typology Analysis as a first step in Gender research.

The technologies offered by DCLAS are embodied in cropping and livestock production systems. Identification of the gender research question of interest, the target social groups and the systemic constraints affecting the different social groups in livelihood systems will be done through activities anchored in flagship 1. Gender issues of equal participation in decision making and access to resources will be researched on in relation to the focus of each DCLAS Flagship. Flagship 2’s focus on agronomic integrated crop and yield improvement requires research on gender- and age differentiated incentives and utilities; Flagship 3’s focus on improved seed system and inputs needs gender- and age-differentiated research on increasing skills in seeds and input management and related income generation activities. Agro-ecological conditions improvement and resources management, the focus of Flagship 4, requires gender-differentiated research on the use of and contribution to water, soil and biodiversity management for example. To improve rural livelihood systems, gender- and age-differentiated interrelations and feedback loops between socio-ecological crop-livestock systems set in various social cultural environments in the drylands are priorities for DCLAS in Flagship 5. Post-harvest and adding value by post-harvesting technology is Flagship 6’s focus,

\(^{10}\) Attracting youth into agriculture in Asia: Contexts and prospects. Asian farmers association for sustainable rural development, Dec 2014

\(^{11}\) Youth employment in Rural Areas; Global donor Platform for rural development, Oct, 2014.
where gender issues with relation to equal economic participation regarding access to and decision over resources come into play. In the past, post-harvest value addition has proven to be an entry point for women to economic empowerment; further research on strengthening this feature, while strengthening nutritional and economic status of society overall, will be a contribution of gender strategic research.

Opportunities for men and women farmers to express their preferences and inclusion in the research processes are a priority for DCLAS. Choice of ‘what technology to use’, ‘access to technology, inputs and resources’ and the systemic factors that influence these process are priority areas for DCLAS. Farmers have technology and inputs they are already using and they have informal resource (e.g. inputs such as seeds) sharing systems embedded in social networks. These are influenced by gender relations. Decision-making in adopting new seeds that may be available away from the usual informal channels requires ‘learning and getting convinced’. The potential of developing business ventures related to the crop-livestock system is an opportunity for DCLAS to empower women or the youth in the drylands to generate income and nutrition for the household and society. Increasing productivity sustainably, adding value to produce and marketing produce is an important lever for causing change in crop-livestock systems, and ultimately impacting income and nutrition outcomes for households, communities and the society as a whole.

Equity in access to resources, incentives for adoption [including policy and institutional arrangements] and how they play out among different social classes and differentiated utility of the benefits are key gender research questions for DCLAS. The gender and social relations factors that influence decision-making on ecosystems management, adaptation to climate change and potential beneficial business opportunities in ecosystem services are priorities for DCLAS gender research related to all flagships.

**OPERATIONALIZING GENDER RESEARCH IN DCLAS AFS CRP**

The gender research will interact with all the flagships in DCLAS. We envisage a conceptual framework with the following flow of activities. We plan to establish platforms that lead to social transformations, increased participation and better outcomes for men, women and the youth in the dryland livelihoods. Challenging sometimes existing social relations, different innovative, inclusive and participatory ‘learning and action platforms’ will be designed and tested in different geographies to create opportunities for the youth and women specifically. The compelling agendas for the learning and action platforms will be selected from the different flagships, depending on how appropriate the ‘solution’ is for the social group and the challenge identified overlaid on the culture and the geography in which its
applied [options by context approach]. The supporting and enabling environment [institutional as well as policy arrangements] will be key components for testing and validation in any lever of engagement. The ‘process and functioning of the inclusive innovation system’ as well as development outcomes and the impacts on technology adoption, empowerment leading to reduction in poverty, improvement in food production and security, nutrition outcomes as well as improvement of the natural ecosystem will be the focus of this activity. Good practices in household diet constitution, positive communication about the role of cereals, legumes, livestock products and vegetables in household diets will be an over-arching theme in the participatory learning and action platforms.

GENDER RESEARCH CAPACITIES AND PARTNERSHIPS
The CRPs forming DCLAS have 5 gender researchers at the senior scientist/scientist level*, 4.5 postdoctoral fellows and 5 MSc level gender research assistants. This team has the experience and competencies to support gender research in DCLAS in the various action sites. DS’s Gender Working Group coordinates the strategic gender research of eight researchers from different CGIAR centres while GL gender team is also working with researchers from three other CGIAR centres. Several of these researchers will continue to cooperate in a future DCLAS Gender Working Group. 10% of the DCLAS AFS budget will be dedicated to staff time and operations that support gender research.

The Gender and Agriculture Network is hiring the Women Studies Department at Pennsylvania State University to support gender researchers and postdocs on ‘Gender Research and Integrated training’ during the current extension phase. They will be ideal partners for support and training for DCLAS gender team. Linkages with Wageningen University and Research Centre, Swedish University of Agricultural Sciences, UNWomen, Michigan State University and Purdue University will be considered.

Monitoring and evaluation of gender research outputs in DCLAS AFS CRP
The CRP DS has currently developed an elaborate M&E systems, which will be adopted and adapted for use in DCLAS [http://mel.cgiar.org]. The system will be used to report the gender research outputs and outcome indicators relating to men and youth inclusion and empowerment in real time and comparison across different action sites in Asia, Africa and Latin America. Some of the gender indicators that will be tracked will include the percentage of women and youth participating in different activities, the household surveys that have sex-disaggregated data, women participating in commercial value chains, youth participating in dryland agriculture, income generated, changes in household nutrition will be among the indicators monitored.

1. 12 Esther Njuguna-Mungai, CRP Grain legumes, ICRISAT
2. Karin Reinprecht, CRP Dryland Systems, ICARDA
3. Amare Tegbaru, CRP Humid Tropics, IITA
4. Dina Najjar, Gender Focal Point, ICARDA
5. Padmaja Ravula, CRP on Policy Institutes and Markets, ICRISAT.

DCLAS PRE-PROPOSAL
ANNEXURES
Annex 1. Water use efficiency, energy, fat, carbohydrate and protein per mm water used for 8 crops in India

<table>
<thead>
<tr>
<th>Crop</th>
<th>Water use efficiency Kg/ha/mm</th>
<th>Energy MJ/ha/mm</th>
<th>Fat kg/ha/mm</th>
<th>Carbohydrate kg/ha/mm</th>
<th>Protein kg/ha/mm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Typical</td>
<td>High</td>
<td>Typical</td>
<td>High</td>
<td>Typical</td>
</tr>
<tr>
<td>Chick peas</td>
<td>1.74</td>
<td>6.25</td>
<td>27</td>
<td>95</td>
<td>0.10</td>
</tr>
<tr>
<td>Groundnuts</td>
<td>2.57</td>
<td>4.14</td>
<td>61</td>
<td>98</td>
<td>1.26</td>
</tr>
<tr>
<td>Millet</td>
<td>2.76</td>
<td>8.01</td>
<td>44</td>
<td>127</td>
<td>0.12</td>
</tr>
<tr>
<td>Pigeon peas</td>
<td>1.67</td>
<td>3.41</td>
<td>24</td>
<td>49</td>
<td>0.03</td>
</tr>
<tr>
<td>Sorghum</td>
<td>1.37</td>
<td>17.72</td>
<td>19</td>
<td>251</td>
<td>0.05</td>
</tr>
<tr>
<td>Soybean</td>
<td>1.74</td>
<td>8.15</td>
<td>32</td>
<td>152</td>
<td>0.35</td>
</tr>
<tr>
<td>Rice, white short grain</td>
<td>3.30</td>
<td>11.29</td>
<td>49</td>
<td>169</td>
<td>0.02</td>
</tr>
<tr>
<td>Corn, yellow</td>
<td>2.34</td>
<td>13.70</td>
<td>41</td>
<td>240</td>
<td>0.25</td>
</tr>
</tbody>
</table>
Annex 2. TARGET COUNTRIES & REGIONAL TRANSECT COUNTRIES OF DCLAS
Annex 3. COUNTRY SELECTION CRITERIA & DATA FOR DCLAS
Country
Burkina Faso +
Ethiopia ++
India +
Kenya +
Malawi +
Mali +
Morocco*
Mozambique +
Nicaragua ++
Niger +
Nigeria ++
Senegal
Sudan
Tanzania ++
Uganda +
Uzbekistan
Zambia +
Bangladesh ++
Benin
Columbia*
DR Congo +
Egypt
Eritrea
Ghana +
Guatemala*
Honduras
Kazakhstan*
Myanmar*
Nepal +
Rwanda +
Turkey*
Vietnam* ++
Zimbabwe

Area under
Land
Per capita
Production of
target crops
Degradation as
rainwater
target crops
(Harvested area,
Area of NDVI
(m3/yr/people
(tonnes, 2013)
Ha, 2013)
decline in km2
in 1km2)
4,714,500
3,932,000
20,864
63,868
3,951,873
7,908,548
228,160
91,888
58,860,000
55,979,200
473,216
106,378
1,708,340
1,037,266
127,424
137,066
1,331,906
1,199,894
38,912
61,137
2,955,312
2,322,787
83,712
122,718
2,307,650
2,997,571
99,712
57,465
2,093,000
697,000
283,392
270,544
348,824
510,548
18,624
769,594
15,655,880
5,880,220
167,360
51,694
15,640,000
17,800,000
69,248
74,331
1,738,372
1,424,347
26,368
143,460
12,426,118
7,639,354
274,816
77,919
3,728,853
3,619,665
453,888
210,247
2,398,000
1,666,130
42,560
108,614
86,450
172,900
35,136
78,304
395,053
413,268
336,064
370,274
270,830
283,910
43,136
148,393
424,869
381,348
4,736
144,806
177,607
295,474
114,176
935,425
917,800
666,550
128,640
938,134
372,900
1,329,000
21,248
4,396
364,400
175,010
7,744
64,682
718,496
820,681
20,352
157,687
308,140
333,190
26,496
406,082
160,450
146,123
24,960
430,009
2,024,426
2,812,380
1,619,584
220,517
5,329,800
7,348,040
311,616
745,665
594,234
648,486
34,688
281,369
655,465
643,980
17,536
46,154
3,603,005
9,363,356
120,640
141,730
587,106
887,301
90,048
362,813
830,750
404,450
203,392
115,074

Target Country

Population
(2014), WB
Estimates
17,419,615
96,506,031
1,267,401,850
45,545,980
16,829,144
15,768,227
33,492,909
26,472,977
6,169,269
18,534,802
178,516,904
14,548,171
38,764,090
50,757,459
38,844,624
29,324,920
15,021,002
158,512,570
10,599,510
48,929,706
4,558,594
83,386,739
6,536,176
26,442,178
15,859,714
8,260,749
16,606,878
53,718,958
28,120,740
12,100,049
75,837,020
92,547,959
14,599,325

Rural
Population
12,370,873
79,333,083
856,997,077
34,063,930
14,111,160
9,957,868
14,023,026
18,005,812
2,562,320
15,083,888
86,682,853
8,222,804
25,705,464
36,486,082
32,311,027
18,656,545
8,940,980
111,177,950
5,634,507
11,689,683
1,599,021
46,673,080
5,050,350
12,213,024
7,749,472
3,811,468
7,746,966
35,271,291
23,058,481
9,675,568
19,601,542
62,065,148
8,747,903

Regional Transect Country *Not Low-Income Food-Deficit Country (LIFDC)

Population
Youth
Undernourished
depend on
Population (Age
Population 2014Agriculture and
group 15-24
15
allied activities
year)
16,686,527
3,700,000
3,447,646
88,338,128
31,600,000
18,770,989
1,082,134,272
194,600,000
218,442,495
36,556,524
9,900,000
7,418,891
16,112,803
3,600,000
3,344,902
15,041,109
788,411
2,990,773
26,631,426
1,674,645
5,926,419
22,985,516
6,900,000
4,830,690
5,126,576
1,036,437
1,234,155
15,479,780
1,800,000
3,099,361
162,890,864
12,900,000
32,786,077
12,129,836
3,700,000
2,665,591
30,017,480
6,738,653
44,543,328
16,800,000
9,302,145
33,665,128
10,300,000
7,233,214
19,936,272
6,085,952
11,558,417
7,400,000
2,767,793
155,761,136
26,471,599
30,387,170
9,459,774
800,000
1,908,335
32,827,356
5,577,986
8,261,154
3,411,668
1,400,000
917,689
68,918,560
15,307,485
5,428,537
1,202,411
22,464,196
1,322,109
5,094,715
12,232,824
2,267,939
3,108,879
7,691,129
1,754,941
9,400,408
830,344
3,447,666
48,100,416
7,700,000
10,216,663
28,740,666
2,200,000
6,640,455
11,650,011
3,900,000
2,241,230
66,525,312
13,624,159
83,468,568
11,938,687
17,176,798
10,534,219
5,000,000
2,867,147

+CG Site Integration + Countries

++CG Site Integration ++ Countries

97
DCLAS PRE-PROPOSAL


Annex 4. DCLAS IMPACT PATHWAY & THEORY OF CHANGE

DCLAS THEORY OF CHANGE – Transition from SUBSISTENCE to MARKET ORIENTED

FP 1
Better informed research agenda for DCLAS and partners

FP 2
Diversified genetic resources and tools for farmers and market preferred traits
1.1.2, 1.2.2, 1.4.3, 1.4.1, 1.4.4

FP 3
Development of high yielding varieties with traits preferred by farmers and markets for food, feed and fodder
AFS

FP 4
Improved access and availability of seeds and other production inputs
AFS

FP 5
Integrated, sustainable crop-livestock systems, management practices and farm mechanization options
AFS, WLE

FP 6
Adaptation strategies for sustainable, productive farming systems integrating crop-tree-livestock in drylands
AFS, CCAFS, PIM, WLE

FP 7
Improved post-harvest storage, processing technologies for novel food formulations
A4NH, AFS, PIM

High-level outcomes

Increased global consumption nutritious DCLAS based food, feeder products
SLO 2

Diversified market-oriented livelihood
SLO 1

Efficiently managed natural resources
SLO 3

Inclusive Innovation Systems for Women and Youth

Policy Research Partnerships

Public Private Research Partnerships

Development partners

Enabling environment for adoption at scale
CCAFS, PIM, WLE

Influencing and enabling policies

Flagship level output
Flagship level outcome
Program level outcome
Sub-DOs CRP-CRP links
# Associated Assumptions, Risks, Behaviour Change and Capacity Change

Flagship level output
Flagship level outcome
Program level outcome
Sub-DOs CRP-CRP links
# Associated Assumptions, Risks, Behaviour Change and Capacity Change

Foresight, priority setting studies; impact adaption
1.1.2, 1.2.2, 1.1.1, D1.4, 1.3.2, D1.2, B1.3

Enabling environment for adoption at scale

1.1.2, 1.2.2, 1.1.1, D1.4, 1.3.2, D1.2, B1.3

Increased resilience and coping capacity; Restoration of degraded land
3.2.1, 3.3.2, 3.3.1, 3.1.1, 3.1.2

Increased productivity with high-value capture for grain, stover and other qualities
SLO 1

Households in rural drylands adopt resilient and risk-mitigated livelihood opportunities improving income and dietary quality.

DCLAS PRE-PROPOSAL
<table>
<thead>
<tr>
<th>#</th>
<th>FP#</th>
<th>CRP-CRP</th>
<th>Assumption</th>
<th>Risk</th>
<th>Behaviour Change</th>
<th>Capacity Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>FP1</td>
<td>CCAFS, PIM, WLE</td>
<td>Researchers and partners use information from the reports and studies to prioritize the R4D activities of DCLAS</td>
<td>Too many iterations, before the process cycle is completed</td>
<td>Researchers and partners acknowledge the priorities and course correct</td>
<td>Improved efficiency of partners in research and development</td>
</tr>
<tr>
<td>B</td>
<td>FP1</td>
<td>PIM</td>
<td>Government ready to enable and implement necessary policies. Development partners are engaged in the process to implement at scale</td>
<td>Competing priorities for governments</td>
<td>Stakeholders adapt to new policies</td>
<td>Understanding the new policies and its objectives</td>
</tr>
<tr>
<td>C</td>
<td>FP2</td>
<td>AFS, A4NH</td>
<td>Input on farmer- and market-preferred traits are captured and considered; Yield stability enhancement and stability</td>
<td>Trait needs change rapidly. Unexpected biotic or abiotic attacks</td>
<td></td>
<td>Clusters are organized based on traits and not crops. Researchers and partners need to utilize the fundamental scientific knowledge and information across crops.</td>
</tr>
<tr>
<td>D</td>
<td>FP3</td>
<td></td>
<td>Farmers are aware about the new varieites and their traits. Varieties perform as expected in the farmer fields</td>
<td>Farmers have accessibility to new varieties; competition from other crops; Alternate variety needs to be in pipeline, if a new variety fails</td>
<td>Farmers change and adapt new varieties</td>
<td>Extension services understand the functional use of new varieites and are able to convine the farmers to change.</td>
</tr>
<tr>
<td>E</td>
<td>FP4</td>
<td>AFS, PIM</td>
<td>Enabling policies, logistical and financial infrastructure in place;</td>
<td>Competition from private industries</td>
<td>Farmers come forward to use new services and avenues to buy seeds and inputs</td>
<td>Capacities of agro input delivery systems in place to cater to the demand at all target locations</td>
</tr>
<tr>
<td>F</td>
<td>FP5</td>
<td>AFS, CCAFS, FTA, WLE</td>
<td>Extension partners understand, adapt and promote the use of integrated, sustainable systems and practices</td>
<td>Lack of enabling policies; incentives to farmers and agro-input industry dealers</td>
<td>Farmers willing to test and adapt new pracices and options without any social, economic barrier</td>
<td>Capacities of NARS and Extension services are built to enable adoption of diversified production and management</td>
</tr>
<tr>
<td>G</td>
<td>FP5</td>
<td>CCAFS, FTA, WLE</td>
<td>Research teams and development partners work together &amp; engage potential beneficiaries</td>
<td>Enabling frameworks and policies for impact @ scale</td>
<td>Communities and partners come together to implement the frameworks</td>
<td>Development partners able to mobilize, and implement land restoration strategies on ground</td>
</tr>
<tr>
<td>H</td>
<td>FP6</td>
<td>CCAFS, FTA, PIM, WLE</td>
<td>Smallholder farmers manage systems, not components. Their management strategies implicitly address synergies and trade-offs amongst system components.</td>
<td>The adoptability of an intervention—innovation is not just governed by factors that are intrinsic to that intervention and thus need to be holistically evaluated in a well-defined system context with a significant extrapolation domain.</td>
<td>Households willing to participate and adopt various options, strategies</td>
<td>National partners' understanding and thought process in a system perspective. Holistic approach towards livelihood Capacities of local partners to evaluate, adapt system</td>
</tr>
<tr>
<td>I</td>
<td>FP7</td>
<td>AFS, A4NH</td>
<td>Adoption of market-preferred varieties by farmers; required technologies and infrastructures supporting product development</td>
<td>Sustained market demand; Trained partners, youth and women are able to succeed in their agri-business ventures</td>
<td>Consumers test, adapt new DCLAS based food, feed and fodder products</td>
<td>Capacities of women, youth entrepreneurs across DCLAS value chain built</td>
</tr>
</tbody>
</table>

Associated Assumptions, Risks, Behaviour Change and Capacity Change
Annex 5. DCLAS COUNTRY ENGAGEMENT FRAMEWORK

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>REDUCED POVERTY</strong></td>
<td><strong>IMPROVED FOOD &amp; NUTRITION SECURITY</strong></td>
<td><strong>IMPROVED NATURAL &amp; RESOURCE SYSTEM</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2022-2030</td>
<td>16 MILLION</td>
<td>45 MILLION</td>
<td>35 MILLION</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2017-2022</td>
<td>8 MILLION</td>
<td>21 MILLION</td>
<td>27 MILLION</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DCLAS GOALS</td>
<td>FAMILIES EXIT POVERTY</td>
<td>FAMILIES ESCAPE HUNGER AND MALNUTRITION</td>
<td>LAND PROTECTED FROM DEGRADATION</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Foresight, priority setting & learning:** Targeted research, increased efficiency and effectiveness in resource use across DCLAS areas.

**Value chains, demand & constraints:** Value chains assessed for inclusiveness and growth potential.

**Climate change (CC) impact analyses:** Prioritized options adjusted for CC and other risks.

**Inclusive innovation Systems:** Women & young people empowered and out of poverty.

**Drivers of adoption & enabling environment:** Technologies matched to farmer demands & contexts.

**Monitoring, impact assessment & scaling:** Scaling out options assessed for impact in collaboration with stakeholders.

**Environmental Classification, TPEs and Phenotyping:** mega-environments characterized.

**Trait discovery:** Stage A concepts developed for identified traits; Stage B varieties/hybrids developed;

**Variety/hybrid development:** Stage C varieties/hybrids developed.

**Variety/hybrid adoption trials:**

**Variety and hybrid characterization:**

**Nursery research and seed production:** remote sensing sites established; testing sites established.

**Variety/hybrid release:** new varieties released.

**Research on seed system and other agro-inputs:** country level seed system, agro-inputs and micro-credit analyses.

**Scaling out seed technologies:** quantity of seed produced and sold.

**Commercial hybrid seed production:** Collaborations established for hybrid seed production; quantity.

**Access to production inputs:** number of micro-credit facilities made accessible.

**Water, land allocation and conservation:** Natural resources use-efficient packages.

**Sustainable land mgt, restoration and C degradation neutral practices & options**

**Integrated soil-crop-water-nutrient management:** Dynamic models and system analysis.

**Cropping pattern, sequance and management:** crop-variety-agronomic practice package developed.

**Mechanization of farm operations:** New mechanization options for small farms.

**Sustainable mgt. of biotic stresses:** IPM package developed.

**System-specific ex-ante analyses and prioritization**

**Studies and Reports prepared and used**

**Testing, adaptation and validation of options**

No. of options tested, adapted and validated.

**Implications of scaling across landscapes**

**Enabling environments for widespread adoption**

**Wider institutional environments**

**Improved technology and knowledge for small-scale processors:** no. of small-scale processing technologies developed.

**Improved postharvest handling and storage:** no. of storage facilities established.

**Diversity for food, feed and fodder**

No. of products developed.

**PIMs:** no. of policies influenced.

**Business incubation Platform**

Number incubators set up.

**Linking with medium and large private enterprises**

No of partnerships.
### Annex 6. ACTIVE W3/BILATERAL PROJECT LIST OF THE DCLAS ALLIANCE – FLAGSHIP 1

<table>
<thead>
<tr>
<th>Flagship &amp; Clusters of Activities</th>
<th>Related Active Current Bilateral and W3 Project (Identify only those with a significant link)</th>
<th>Bilateral or W3?</th>
<th>CG Center</th>
<th>Budget US $ '000s</th>
<th>Donor</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FP1: Priority Setting &amp; Impact Acceleration</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP1</td>
<td>100% - Gender Postdoctoral Fellowship - Grain Legumes</td>
<td>Bilateral</td>
<td>ICRISAT</td>
<td>36</td>
<td>CGIAR Consortium</td>
</tr>
<tr>
<td>Multiple CoAs in FP1</td>
<td>20% - Improving the Livelihoods of Smallholder Farmers in Drought-prone Areas of Sub-Saharan Africa and India through Enhanced Grain Legume Production and Productivity - Tropical Legumes II, Phase 2 (Bill and Melinda Gates Foundation (BMGF), USA)</td>
<td>Bilateral</td>
<td>ICRISAT</td>
<td>232</td>
<td>CGIAR/BMFG</td>
</tr>
<tr>
<td>Multiple CoAs in FP1</td>
<td>15% - Tropical Legumes III - Improving Livelihoods for Smallholder Farmers: Enhanced Grain Legume Productivity and Production in Sub-Saharan Africa and South Asia (Bill and Melinda Gates Foundation (BMGF), USA)</td>
<td>Bilateral</td>
<td>ICRISAT</td>
<td>511</td>
<td>CGIAR/BMFG</td>
</tr>
<tr>
<td>Multiple CoAs in FP1</td>
<td>100% - Training Programs for Chinese Young Scientists (China)</td>
<td>Bilateral</td>
<td>ICRISAT</td>
<td>47</td>
<td>CGIAR/China</td>
</tr>
<tr>
<td>Multiple CoAs in FP1</td>
<td>100% - Supporting Collaborative Projects in China (China)</td>
<td>Bilateral</td>
<td>ICRISAT</td>
<td>62</td>
<td>CGIAR/China</td>
</tr>
<tr>
<td>Multiple CoAs in FP1</td>
<td>50% - Strengthening Partnerships for Innovation in Beans, Groundnuts and Sesame Research and Technology Transfer in Mozambique -(USAID)</td>
<td>Bilateral</td>
<td>ICRISAT</td>
<td>164</td>
<td>IITA/?USAID</td>
</tr>
<tr>
<td>Multiple CoAs in FP1</td>
<td>10% - Food legumes for enhanced food and nutritional security, systems productivity and profitability of smallholder farmers in Ethiopia and Uganda&quot;</td>
<td>Bilateral</td>
<td>ICRISAT</td>
<td>10</td>
<td>Austrian Development Agency (ADA), Austria</td>
</tr>
<tr>
<td>Multiple CoAs in FP1</td>
<td>10% - Introduction and Expansion of Improved Pigeonpea (Arhar) Production Technology (IPPT) in Rainfed Upland Ecosystems of Odisha</td>
<td>Bilateral</td>
<td>ICRISAT</td>
<td>4</td>
<td>Government of Odisha, India</td>
</tr>
<tr>
<td>Multiple CoAs in FP1</td>
<td>10% - Promotion of Improved Chickpea Varieties in Rice - Based Cropping Systems of Smallholder Farmers in Odisha</td>
<td>Bilateral</td>
<td>ICRISAT</td>
<td>26</td>
<td>Government of Odisha , India</td>
</tr>
<tr>
<td>Multiple CoAs in FP1</td>
<td>10% - Development of Hybrid Pigeonpea Technology Suitable for Rajasthan</td>
<td>Bilateral</td>
<td>ICRISAT</td>
<td>3</td>
<td>Swami Keshwanand Rajasthan Agricultural University, Government of Rajasthan, India</td>
</tr>
<tr>
<td>Multiple CoAs in FP1</td>
<td>10% - Enhancing Livelihoods of Resource-poor Farmers of Rajasthan through Introduction of Eco-friendly Pigeonpea Varieties</td>
<td>Bilateral</td>
<td>ICRISAT</td>
<td>13</td>
<td>Swami Keshwanand Rajasthan Agricultural University,</td>
</tr>
<tr>
<td>Multiple CoAs in FP1</td>
<td>30% - Innovative Communication Media and Methods for More Effective Aflatoxin Mitigation, Variety Uptake, and Use Intervention in Groundnut in Malawi and Tanzania</td>
<td>ICRISAT</td>
<td>4</td>
<td>McKnight Foundation</td>
<td></td>
</tr>
<tr>
<td>---------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>--------</td>
<td>-----</td>
<td>---------------------</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP1</td>
<td>10% - Collaborate to Increase and Enhance Chickpea and Pigeonpea Production Technologies in the Farmers' Fields of the Districts of Andhra Pradesh and Karnataka under India Food Legumes Initiative</td>
<td>ICRISAT</td>
<td>19</td>
<td>OCP Foundation, Morocco</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP1</td>
<td>10% - Sustainable Intensification of Maize - Legume Cropping Systems for Food Security in Eastern and Southern Africa (SIMLESA)</td>
<td>ICRISAT</td>
<td>38</td>
<td>CIMMYT (ACIAR grant)</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP1</td>
<td>10% - Diversification of Pigeonpea Hybrid Parents for Increased Stable Production</td>
<td>ICRISAT</td>
<td>1</td>
<td>Seed Companies (Appendix 3)</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP1</td>
<td>10% - Aflatoxin Management Interventions, Education, and Analysis at Various Steps within the Peanut Value Chain in Malawi, Mozambique and Zambia</td>
<td>ICRISAT</td>
<td>2</td>
<td>North Carolina University (NCSU), USA</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP1</td>
<td>1</td>
<td>Bilateral</td>
<td>ICARDA</td>
<td>107,542</td>
<td>Other</td>
</tr>
<tr>
<td>Multiple CoAs in FP1</td>
<td>Fellowships Program and post graduate scholarships for implementing and managing agricultural research in the Arab countries</td>
<td>Bilateral</td>
<td>ICARDA</td>
<td>238,857</td>
<td>Other</td>
</tr>
<tr>
<td>Multiple CoAs in FP1</td>
<td>Updated Collaboration Agreement for Strengthening Agricultural Research</td>
<td>W3</td>
<td>ICARDA</td>
<td>315,705</td>
<td>Other</td>
</tr>
<tr>
<td>Multiple CoAs in FP1</td>
<td>Support to agriculture Research for development of strategic crop in africa (SARD-SC)</td>
<td>Bilateral</td>
<td>ICARDA</td>
<td>4,639,629</td>
<td>AfDB</td>
</tr>
<tr>
<td>1.6. Monitoring adoption, impact assessment &amp; scaling</td>
<td>VDSA</td>
<td>Bilateral</td>
<td>ICRISAT</td>
<td>$2m pa</td>
<td>BMGF</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Flagship &amp; Clusters of Activities</th>
<th>Related Active Current Bilateral and W3 Project (Identify only those with a significant link)</th>
<th>Bilateral or W3?</th>
<th>CG Center</th>
<th>Budget</th>
<th>Donor</th>
<th>Project Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FP2,3: Crop Improvement</strong></td>
<td>60% - Improving the Livelihoods of Smallholder Farmers in Drought-prone Areas of Sub-Saharan Africa and India through Enhanced Grain Legume Production and Productivity - Tropical Legumes II, Phase 2 (Bill and Melinda Gates Foundation (BMGF), USA)</td>
<td>W3</td>
<td>ICRISAT</td>
<td>697,200</td>
<td>CGIAR/BMGF</td>
<td>not available</td>
</tr>
<tr>
<td>Multiple CoAs in FP2,3</td>
<td>55% - Tropical Legumes III - Improving Livelihoods for Smallholder Farmers: Enhanced Grain Legume Productivity and Production in Sub-Saharan Africa and South Asia (Bill and Melinda Gates Foundation (BMGF), USA)</td>
<td>W3</td>
<td>ICRISAT</td>
<td>1,872,099</td>
<td>CGIAR/BMGF</td>
<td>not available</td>
</tr>
<tr>
<td>Multiple CoAs in FP2,3</td>
<td>100% - Pigeonpea Improvement using Molecular Breeding (USAID)</td>
<td>W3</td>
<td>ICRISAT</td>
<td>728,000</td>
<td>CGIAR/USAID</td>
<td>not available</td>
</tr>
<tr>
<td>Multiple CoAs in FP2,3</td>
<td>100% - Understanding Molecular Defence Mechanism and Identification of Candidate Genes for Resistance to Aspergillus Infection and Aflatoxin Cantamination in Groundnut</td>
<td>ICRISAT</td>
<td></td>
<td>50,000</td>
<td>IFPRI</td>
<td>not available</td>
</tr>
<tr>
<td>Multiple CoAs in FP2,3</td>
<td>100% - Development and Promotion of Promising Varieties/Lines with High Yield and High Oil Content with Enhanced O/L Ratio for Enhancing Production and Quality of Groundnut Oil in Drought Prone Environment to Boost the Income of Small &amp; Marginal Groundnut Farmers in India</td>
<td>ICRISAT</td>
<td></td>
<td>0</td>
<td>Department of Agriculture &amp; Corporation, India</td>
<td>not available</td>
</tr>
<tr>
<td>Multiple CoAs in FP2,3</td>
<td>100% - Genomic Approaches for Stress Tolerant Chickpea</td>
<td>ICRISAT</td>
<td></td>
<td>298,000</td>
<td>Department of Science &amp; Technology, India</td>
<td>not available</td>
</tr>
<tr>
<td>Multiple CoAs in FP2,3</td>
<td>100% - Innovation in Science Pursuit for Inspired Research (INSPIRE) - Faculty Award for Dr. Hima Bindu Kudapa</td>
<td>ICRISAT</td>
<td></td>
<td>16,000</td>
<td>Department of Science &amp; Technology, India</td>
<td>not available</td>
</tr>
<tr>
<td>Title</td>
<td>Award Title</td>
<td>Amount</td>
<td>Department</td>
<td>Remarks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>-------------</td>
<td>--------</td>
<td>------------</td>
<td>---------</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Multiple CoAs in FP2,3</strong></td>
<td><strong>100% - Innovation in Science Pursuit for Inspired Research (INSPIRE) - Faculty Award for Dr. Santisree Parankusam</strong></td>
<td>31,000</td>
<td>Department of Science &amp; Technology, India</td>
<td>not available</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Multiple CoAs in FP2,3</strong></td>
<td><strong>100% - Understanding the Drought Tolerance Mechanism in Chickpea using Epigenetics (INSPIRE) - Faculty Award for Dr. Manish Roorkiwal</strong></td>
<td>20,000</td>
<td>Department of Science &amp; Technology, India</td>
<td>not available</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Multiple CoAs in FP2,3</strong></td>
<td><strong>100% - Tracking Breeding - Induced Genomic Genome changes in pigeonpea (Cajanus Cajan (L) Millsp.)</strong></td>
<td>26,000</td>
<td>Department of Science and Technology (thru Science and Engineering Research Board (SERB), India</td>
<td>not available</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Multiple CoAs in FP2,3</strong></td>
<td><strong>100% - Pre-breeding for Chickpea Improvement</strong></td>
<td>9,000</td>
<td>Department of Science and Technology (thru Science and Engineering Research Board (SERB), India</td>
<td>not available</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Multiple CoAs in FP2,3</strong></td>
<td><strong>100% - Pathological, Cultural Variability and Sequence Diversity in Rhizoctonia Bataticola Causing Dry Root Rot of Chickpea</strong></td>
<td>12,000</td>
<td>Department of Science and Technology (thru Science and Engineering Research Board (SERB), India</td>
<td>not available</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Multiple CoAs in FP2,3</strong></td>
<td><strong>100% - Tracking Aspergillus Flavus Toxigenic Strain AF 11-4 in Groundnut Crop Soils Using SCAR Marker Based PCR Diagnostic Assay</strong></td>
<td>4,000</td>
<td>Department of Science and Technology (thru Science and Engineering Research Board (SERB), India</td>
<td>not available</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Multiple CoAs in FP2,3</strong></td>
<td><strong>100% - Challenge Initiatives Projects - 2010</strong></td>
<td>279,000</td>
<td>CIMMYT: CP-Generation</td>
<td>not available</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Multiple CoAs in FP2,3</strong></td>
<td><strong>100% - Chickpea Genome Sequencing and Analysis</strong></td>
<td>192,000</td>
<td>ICARDA</td>
<td>not available</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Multiple CoAs in FP2,3</strong></td>
<td><strong>100% - Translational Genomics to Reduce Pre-harvest Aflatoxin Contamination of Peanut</strong></td>
<td>180,000</td>
<td>The University of Georgia Research Foundation Inc.</td>
<td>not available</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Multiple CoAs in FP2,3</strong></td>
<td><strong>100% - An Integrated Global Breeding and Genomics Approach to Intensifying Peanut Production and Quality</strong></td>
<td>146,000</td>
<td>The University of Georgia Research Foundation Inc.</td>
<td>not available</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Multiple CoAs in FP2,3</strong></td>
<td><strong>100% - Genome-wide Association Studies (GWAS) to Identify Markers Associated with Target Traits for Peanut Breeding using Diverse Global Germplasm Collections</strong></td>
<td>108,000</td>
<td>The Regents of the University of California</td>
<td>not available</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project Title</td>
<td>Percentage</td>
<td>Implementer</td>
<td>Funding Agency</td>
<td>Status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------------------------------------------------------------------------</td>
<td>------------</td>
<td>-------------</td>
<td>----------------</td>
<td>--------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Genetic Diversity of Aflatoxicogenic Aspergillus Species in African Countries</td>
<td>100%</td>
<td>ICRISAT</td>
<td>United States Department of Agriculture - USDA, USA</td>
<td>not available</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zambia Groundnut Productivity (USAID)</td>
<td>50%</td>
<td>W3</td>
<td>CGIAR/USAID</td>
<td>not available</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zambia Aflatoxin Research &amp; Mitigation (USAID)</td>
<td>60%</td>
<td>ICRISAT</td>
<td>CGIAR/USAID</td>
<td>not available</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enhancing Productivity of Groundnut and Pigeonpea Cropping Systems in Eastern Africa - EU / IFAD -</td>
<td>70%</td>
<td>ICRISAT</td>
<td>CGIAR/IFAD</td>
<td>not available</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Improving Soil Fertility, Productivity and Livelihoods of Smallholder Farmers in Tanzania through Intensification and Diversification of Pigeonpea Cropping Systems - (Alliance for a Green Revolution in Africa - AGRA)</td>
<td>10%</td>
<td>ICRISAT</td>
<td>SARI, Tanzania</td>
<td>not available</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Improving Soil Fertility Productivity and Livelihoods of Smallholder Farmers in Northern Uganda by Intensifying Diversification of Pigeonpea Cropping Systems</td>
<td>10%</td>
<td>ICRISAT</td>
<td>Alliance for a Green Revolution in Africa (AGRA)</td>
<td>not available</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Food legumes for enhanced food and nutritional security, systems productivity and profitability of smallholder farmers in Ethiopia and Uganda&quot;</td>
<td>30%</td>
<td>ICRISAT</td>
<td>Austrian Development Agency (ADA), Austria</td>
<td>not available</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sustainable Management of Crop-based Production Systems for Raising Agricultural Productivity in Rainfed Asia</td>
<td>10%</td>
<td>ICRISAT</td>
<td>IFAD</td>
<td>not available</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Developing Chickpea Cultivars Suited to Mechanical Harvesting and Tolerant to Herbicides</td>
<td>90%</td>
<td>ICRISAT</td>
<td>Department of Agriculture &amp; Cooperation, India</td>
<td>not available</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Addressing Phytophthora Blight Disease: an Emerging Threat to Pigeonpea Expansion and Production</td>
<td>90%</td>
<td>ICRISAT</td>
<td>Department of Agriculture &amp; Cooperation, India</td>
<td>not available</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Utilizing Chickpea Genome Sequence for Crop Improvement</td>
<td>95%</td>
<td>ICRISAT</td>
<td>Department of Agriculture &amp; Cooperation, India</td>
<td>not available</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crop Biofortification of Groundnut and Pigeonpea for Alleviating Vitamin A Deficiencies in India</td>
<td>100%</td>
<td>ICRISAT</td>
<td>Department of Biotechnology, India</td>
<td>not available</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Genomics Assisted Accelerated Product Development of High Yielding Pigeonpea Hybrids</td>
<td>95%</td>
<td>ICRISAT</td>
<td>Department of Biotechnology, India</td>
<td>not available</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP2,3</td>
<td>90% - Biofortification of Long Chain Polyunsaturated Fatty Acids in Peanut by Metabolic Engineering of Fatty Acid Biosynthetic Pathway</td>
<td>ICRISAT</td>
<td>17,100</td>
<td>Department of Biotechnology, India</td>
<td>not available</td>
<td></td>
</tr>
<tr>
<td>-----------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------</td>
<td>---------</td>
<td>--------</td>
<td>----------------------------------</td>
<td>--------------</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP2,3</td>
<td>40% - Biofertilization and Bioirrigation for Sustainable Mixed Cropping of Pigeonpea and Finger Millet (BIOFI) under Indo-Swiss Collaboration in Biotechnology</td>
<td>ICRISAT</td>
<td>12,400</td>
<td>Department of Biotechnology, India</td>
<td>not available</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP2,3</td>
<td>90% - Development of Actinomycetes based Metabolites as Delivery Systems for Soil, Health Management in Groundnut (Arachis Hypogaea L.)</td>
<td>ICRISAT</td>
<td>12,600</td>
<td>Department of Biotechnology, India</td>
<td>not available</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP2,3</td>
<td>90% - DST-ICRISAT Center of Excellence (CoE) on Climate Change Research for Plant Protection (CCRPP)</td>
<td>ICRISAT</td>
<td>42,300</td>
<td>Department of Science and Technology, India</td>
<td>not available</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP2,3</td>
<td>90% - Characterization of Defensive Insectidal Proteins (lectins and serpins) from Plants for Deployment in Transgenic Crops Controlling Cotton Bollworm, Helicoverpa armigera</td>
<td>ICRISAT</td>
<td>8,100</td>
<td>Department of Science and Technology (thru Science and Engineering Research Board (SERB), India</td>
<td>not available</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP2,3</td>
<td>90% - Assessment of Actinomycetes as Tripatrite Agent: Biocontrol of Botrytis Grey Mold, Host-Plant Resistance Enhancer and Growth Promoter on Chickpea (Cicer Arietinum L.)</td>
<td>ICRISAT</td>
<td>27,900</td>
<td>Department of Science and Technology (thru Science and Engineering Research Board (SERB), India</td>
<td>not available</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP2,3</td>
<td>80% - Genomics-assisted Breeding for High Yielding and Climate Resilient Pigeonpea Varfieties/Hybrids and Promotion Promotion of Best Suitable Cultivars for Food and Nutritional Security in Karnataka State in India</td>
<td>ICRISAT</td>
<td>48,000</td>
<td>Government of Karnataka</td>
<td>not available</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP2,3</td>
<td>70% - Introduction and Expansion of Improved Pigeonpea (Arhar) Production Technology (IPPT) in Rainfed Upland Ecosystems of Odisha</td>
<td>ICRISAT</td>
<td>27,300</td>
<td>Government of Odisha, India</td>
<td>not available</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP2,3</td>
<td>10% - Development of Hybrid Pigeonpea Technology Suitable for Rajasthan</td>
<td>ICRISAT</td>
<td>2,800</td>
<td>Swami Keshwanand Rajasthan Agricultural University, Government of Rajasthan, India</td>
<td>not available</td>
<td></td>
</tr>
<tr>
<td>Project Title</td>
<td>Percentage</td>
<td>CoAs</td>
<td>Implementation Details</td>
<td>Funding Agency</td>
<td>University/Location</td>
<td>Available</td>
</tr>
<tr>
<td>------------------------------------------------------------------------------</td>
<td>------------</td>
<td>------</td>
<td>------------------------------------------------------------------------------------------------------------</td>
<td>----------------</td>
<td>---------------------</td>
<td>----------</td>
</tr>
<tr>
<td>Enhancing Livelihoods of Resource-poor Farmers of Rajasthan through</td>
<td>10%</td>
<td>ICRISAT</td>
<td>Introduction of Eco-friendly Pigeonpea Varieties</td>
<td>Swami Keshwanand</td>
<td>Rajasthan Agricultural University, Government of Rajasthan, India</td>
<td>not available</td>
</tr>
<tr>
<td>Innovative Communication Media and Methods for More Effective Aflatoxin</td>
<td>20%</td>
<td>ICRISAT</td>
<td>Mitigation, Variety Uptake, and Use Intervention in Groundnut in Malawi and Tanzania</td>
<td>McKnight Foundation</td>
<td>not available</td>
<td>not available</td>
</tr>
<tr>
<td>Collaborate to Increase and Enhance Chickpea and Pigeonpea Production</td>
<td>10%</td>
<td>ICRISAT</td>
<td>Technologies in the Farmers' Fields of the Districts of Andhra Pradesh and Karnataka under India Food</td>
<td>OCP Foundation, Morocco</td>
<td>not available</td>
<td>not available</td>
</tr>
<tr>
<td>Sustainable Intensification of Maize - Legume Cropping Systems for Food</td>
<td>20%</td>
<td>ICRISAT</td>
<td>Security in Eastern and Southern Africa (SIMLESIA)</td>
<td>CIMMYT (ACIAR grant)</td>
<td>not available</td>
<td>not available</td>
</tr>
<tr>
<td>Diversification of Pigeonpea Hybrid Parents for Increased Stable Production</td>
<td>10%</td>
<td>ICRISAT</td>
<td></td>
<td>Seed Companies (Appendix 3)</td>
<td>not available</td>
<td>not available</td>
</tr>
<tr>
<td>Groundnut and Chickpea Varietal Development Research Consortium</td>
<td>30%</td>
<td>ICRISAT</td>
<td></td>
<td>Seed Companies (Appendix 3)</td>
<td>not available</td>
<td>not available</td>
</tr>
<tr>
<td>Field Testing of ICRISAT Legumes Varieties and Technologies in Selected</td>
<td>90%</td>
<td>ICRISAT</td>
<td>Regions Phase 2</td>
<td>The Bureau of Agricultural Research, Philippines</td>
<td>not available</td>
<td>not available</td>
</tr>
<tr>
<td>Evaluation of Pigeonpea Varieties under Various Cropping Systems for</td>
<td>90%</td>
<td>ICRISAT</td>
<td>Special Purposes Across Locations</td>
<td>Isabela State University, Philippines</td>
<td>not available</td>
<td>not available</td>
</tr>
<tr>
<td>Benchmarking of Traits Controlling the Plant Water Budget in Orphan Legumes</td>
<td>90%</td>
<td>ICRISAT</td>
<td></td>
<td>Kirkhouse Trust, UK</td>
<td>not available</td>
<td>not available</td>
</tr>
<tr>
<td>Aflatoxin Management Interventions, Education, and Analysis at Various</td>
<td>40%</td>
<td>ICRISAT</td>
<td>Steps within the Peanut Value Chain in Malawi, Mozambique and Zambia</td>
<td>North Carolina University (NCSU), USA</td>
<td>not available</td>
<td>not available</td>
</tr>
<tr>
<td>Global Hunger and Food Security Research Strategy : Climate Resilience,</td>
<td>70%</td>
<td>ICRISAT</td>
<td>Nutrition, and Policy - Feed the Future Innovation Lab for Climate Resilient Chickpea</td>
<td>The Regents of the University of California</td>
<td>not available</td>
<td>not available</td>
</tr>
<tr>
<td>Multiple CoAs in FP2,3</td>
<td><strong>10% - Enhancing Productivity and Competitiveness of Groundnut-based Cropping Systems in Malawi by Developing and Deploying Labor Saving and Drudgery Reducing Technologies in the Groundnut Value Chain</strong></td>
<td>ICRISAT</td>
<td>9,500</td>
<td>McKnight Foundation</td>
<td>not available</td>
<td></td>
</tr>
<tr>
<td>------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>----------</td>
<td>---------</td>
<td>------------------</td>
<td>----------------</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP2,3</td>
<td><strong>90% - Improving Widely Grown Groundnut Cultivars by Introgressing Genes for Resistance to Foliar Fungal Diseases (LLS and rust) and High Oil Quality (O/L ratio)</strong></td>
<td>ICRISAT</td>
<td>252,900</td>
<td>MARS, USA</td>
<td>not available</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP2,3</td>
<td><strong>100% - Delivering High-Density Genomics Breeder’s Tools (Bill and Melinda Gates Foundation (BMGF), USA)</strong></td>
<td>ICRISAT</td>
<td>257,500</td>
<td>Cornell University, USA</td>
<td>not available</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP2,3</td>
<td><strong>100% - Collaboration and Establishment of A Regional Hub of the Integrated Breeding Platform</strong></td>
<td>ICRISAT</td>
<td>50,000</td>
<td>CIMMYT: CP-Generation</td>
<td>not available</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP2,3</td>
<td>Africa Rising</td>
<td>Bilateral</td>
<td>ICARDA</td>
<td>93,575</td>
<td>USAID</td>
<td>not available</td>
</tr>
<tr>
<td>Multiple CoAs in FP2,3</td>
<td>Africa Rising</td>
<td>Bilateral</td>
<td>ICARDA</td>
<td>97,557</td>
<td>USAID</td>
<td>not available</td>
</tr>
<tr>
<td>Multiple CoAs in FP2,3</td>
<td>Africa Rising</td>
<td>Bilateral</td>
<td>ICARDA</td>
<td>180,498</td>
<td>USAID</td>
<td>not available</td>
</tr>
<tr>
<td>multiple CoAs</td>
<td><strong>75% - Feed the Future Innovation Lab for Climate Resilient Cowpea</strong></td>
<td>Bilateral</td>
<td>IITA</td>
<td>112,500</td>
<td>UC RIVERSIDE</td>
<td>not available</td>
</tr>
<tr>
<td>2.2. Trait Discovery &amp; Development</td>
<td><strong>20% - Nigeria Maize and Soybean Transformation Initiative</strong></td>
<td>Bilateral</td>
<td>IITA</td>
<td>857,930</td>
<td>FMARD</td>
<td>not available</td>
</tr>
<tr>
<td>2.2. Trait Discovery &amp; Development</td>
<td>Nigeria Maize and Soybean Transformation Initiative</td>
<td>Bilateral</td>
<td>IITA</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.2. Trait Discovery &amp; Development</td>
<td>Developing and delivering Common Bean Germplasm with resistance to major soil borne pathogens in East Africa (60%), An Integrated program to accelerate breeding of resilient, more productive beans for smallholders farmers (40%);</td>
<td>CIAT</td>
<td>112,978</td>
<td></td>
<td>Identifying biotic and abiotic sources of resistance</td>
<td></td>
</tr>
<tr>
<td>2.2. Trait Discovery &amp; Development</td>
<td>Establishment of commercially valuable sorghum lines with drought tolerance and photoperiod insensitivity</td>
<td>Bilateral</td>
<td>ICRISAT</td>
<td>0.125m (2015-2017)</td>
<td>EARTHNOTE, Japan</td>
<td>The principle aim of this project is to develop a sorghum line with drought tolerance and/or photoperiod insensitivity while maintaining biomass yield, and to investigate the regulatory mechanisms underlying these traits.</td>
</tr>
<tr>
<td>3.2. Variety Development</td>
<td>Developing and delivering Common Bean Germplasm with resistance to major soil borne pathogens in East Africa (40%), An Integrated program to accelerate breeding of resilient, more productive beans for smallholders farmers (30%);</td>
<td>CIAT</td>
<td>80,204</td>
<td>Prebreeding and markers for biotic and abiotic resistance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.2. Trait Discovery &amp; Development</td>
<td>Developing and delivering Common Bean Germplasm with resistance to major soil borne pathogens in East Africa (40%), An Integrated program to accelerate breeding of resilient, more productive beans for smallholders farmers (30%);</td>
<td>Bilateral</td>
<td>IITA</td>
<td>496,292</td>
<td>GCP</td>
<td></td>
</tr>
<tr>
<td>2.2. Trait Discovery &amp; Development</td>
<td>Developing and delivering Common Bean Germplasm with resistance to major soil borne pathogens in East Africa (40%), An Integrated program to accelerate breeding of resilient, more productive beans for smallholders farmers (30%);</td>
<td>CIAT</td>
<td>979,516</td>
<td>Developing varieties with biotic and abiotic resistance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.2. Trait Discovery &amp; Development</td>
<td>Developing and delivering Common Bean Germplasm with resistance to major soil borne pathogens in East Africa (40%), An Integrated program to accelerate breeding of resilient, more productive beans for smallholders farmers (30%);</td>
<td>ICRISAT</td>
<td>0.125m (2015-2017)</td>
<td>EARTHNOTE, Japan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Establishment of commercially valuable sorghum lines with drought tolerance and photoperiod insensitivity</td>
<td>The principle aim of this project is to develop a sorghum line with drought tolerance and/or photoperiod insensitivity while maintaining biomass yield, and to investigate the regulatory mechanisms underlying these traits.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.6. Varietal Release</td>
<td>Tropical Legumes III: Improving the Livelihoods of Smallholder Farmers: Enhanced Grain Legume Productivity and Production in Sub-Saharan Africa and South Asia (10%); PABRA (10%);</td>
<td>CIAT</td>
<td>353,014</td>
<td>Supporting NARS in testing and release</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.6. Varietal Release</td>
<td>Tropical Legumes III: Improving the Livelihoods of Smallholder Farmers: Enhanced Grain Legume Productivity and Production in Sub-Saharan Africa and South Asia (10%); PABRA (10%)</td>
<td>CIAT</td>
<td>353,014</td>
<td>Production of breeder seed</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### ANNEX 6. ACTIVE W3/BILATERAL PROJECT LIST OF THE DCLAS ALLIANCE – FLAGSHIP 4

<table>
<thead>
<tr>
<th>Flagship &amp; Clusters of Activities</th>
<th>Related Active Current Bilateral and W3 Project (Identify only those with a significant link)</th>
<th>Bilateral W3?</th>
<th>CG Center</th>
<th>Budget</th>
<th>Donor</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FP4: Seed Systems &amp; Input Services</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP4</td>
<td><strong>20%</strong> - Improving the Livelihoods of Smallholder Farmers in Drought-prone Areas of Sub-Saharan Africa and India through Enhanced Grain Legume Production and Productivity - Tropical Legumes II, Phase 2 (Bill and Melinda Gates Foundation (BMGF), USA)</td>
<td></td>
<td>ICRISAT</td>
<td>232,400</td>
<td>CGIAR/BMGF</td>
</tr>
<tr>
<td>Multiple CoAs in FP4</td>
<td><strong>30%</strong> - Tropical Legumes III - Improving Livelihoods for Smallholder Farmers; Enhanced Grain Legume Productivity and Production in Sub-Saharan Africa and South Asia (Bill and Melinda Gates Foundation (BMGF), USA)</td>
<td></td>
<td>ICRISAT</td>
<td>4,061,824</td>
<td>CGIAR/BMGF</td>
</tr>
<tr>
<td>Multiple CoAs in FP4</td>
<td><strong>100%</strong> - Platform Mozambique - Legumes (USAID)</td>
<td></td>
<td>ICRISAT</td>
<td>257,000</td>
<td>USAID</td>
</tr>
<tr>
<td>Multiple CoAs in FP4</td>
<td><strong>100%</strong> - US - CGIAR Linkage Program (USAID) - CRP - Grain Legumes</td>
<td></td>
<td>ICRISAT</td>
<td>266,000</td>
<td>CGIAR/USAID</td>
</tr>
<tr>
<td>Multiple CoAs in FP4</td>
<td><strong>50%</strong> - Zambia Groundnut Productivity (USAID)</td>
<td></td>
<td>ICRISAT</td>
<td>168,000</td>
<td>USAID</td>
</tr>
<tr>
<td>Multiple CoAs in FP4</td>
<td><strong>50%</strong> - Strengthening Partnerships for Innovation in Beans, Groundnuts and Sesame Research and Technology Transfer in Mozambique -(USAID)</td>
<td></td>
<td>ICRISAT</td>
<td>163,500</td>
<td>USAID</td>
</tr>
<tr>
<td>Multiple CoAs in FP4</td>
<td><strong>50%</strong> - Intensification of Maize-Legume based Systems in the Semi-Arid Areas of Tanzania (Kongwa and Kiteto Districts) to Increase Farm Productivity and Improve Farming Natural Resource Base - ( USAID)</td>
<td></td>
<td>ICRISAT</td>
<td>212,000</td>
<td>USAID</td>
</tr>
<tr>
<td>Multiple CoAs in FP4</td>
<td><strong>50%</strong> - Reseeding Malawi’s Smallholder Agriculture (USAID)</td>
<td></td>
<td>ICRISAT</td>
<td>3,405,500</td>
<td>USAID</td>
</tr>
<tr>
<td>Multiple CoAs in FP4</td>
<td><strong>30%</strong> - Enhancing Productivity of Groundnut and Pigeonpea Cropping Systems in Eastern Africa - EU / IFAD -</td>
<td></td>
<td>ICRISAT</td>
<td>216,600</td>
<td>CGIAR/IFAD</td>
</tr>
<tr>
<td>Multiple CoAs in FP4</td>
<td><strong>40%</strong> - Improving Soil Fertility, Productivity and Livelihoods of Smallholder Farmers in Tanzania through Intensification and Diversification of Pigeonpea Cropping Systems - (Alliance for a Green Revolution in Africa - AGRA)</td>
<td>ICRISAT</td>
<td>8,800</td>
<td>SARI, Tanzania</td>
<td></td>
</tr>
<tr>
<td>---------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>--------</td>
<td>------</td>
<td>----------------</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP4</td>
<td><strong>40%</strong> - Improving Soil Fertility Productivity and Livelihoods of Smallholder Farmers in Northern Uganda by Intensifying Diversification of Pigeonpea Cropping Systems</td>
<td>ICRISAT</td>
<td>44,000</td>
<td>Alliance for a Green Revolution in Africa (AGRA)</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP4</td>
<td><strong>50%</strong> - Increasing Productivity of Legume-Based Farming Systems in the Central Dry Zone of Myanmar Project</td>
<td>ICRISAT</td>
<td>101,000</td>
<td>ACIAR, Australia</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP4</td>
<td><strong>30%</strong> - Food legumes for enhanced food and nutritional security, systems productivity and profitability of smallholder farmers in Ethiopia and Uganda”</td>
<td>ICRISAT</td>
<td>180,000</td>
<td>Austrian Development Agency (ADA), Austria</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP4</td>
<td><strong>30%</strong> - Sustainable Management of Crop-based Production Systems for Raising Agricultural Productivity in Rainfed Asia</td>
<td>ICRISAT</td>
<td>211,200</td>
<td>IFAD</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP4</td>
<td><strong>10%</strong> - Developing Chickpea Cultivars Suited to Mechanical Harvesting and Tolerant to Herbicides</td>
<td>ICRISAT</td>
<td>90,300</td>
<td>Department of Agriculture &amp; Cooperation, India</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP4</td>
<td><strong>10%</strong> - Addressing Phytophthora Blight Disease: an Emerging Threat to Pigeonpea Expansion and Production</td>
<td>ICRISAT</td>
<td>45,400</td>
<td>Department of Agriculture &amp; Cooperation, India</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP4</td>
<td><strong>5%</strong> - Utilizing Chickpea Genome Sequence for Crop Improvement</td>
<td>ICRISAT</td>
<td>65,250</td>
<td>Department of Agriculture &amp; Cooperation, India</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP4</td>
<td><strong>5%</strong> - Genomics Assisted Accelerated Product Development of High Yielding Pigeonpea Hybrids</td>
<td>ICRISAT</td>
<td>4,150</td>
<td>Department of Biotechnology, India</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP4</td>
<td><strong>60%</strong> - Biofertilization and Bioirrigation for Sustainable Mixed Cropping of Pigeonpea and Finger Millet (BIOFI) under Indo-Swiss Collaboration in Biotechnology</td>
<td>ICRISAT</td>
<td>42,000</td>
<td>Department of Biotechnology, India</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP4</td>
<td><strong>10%</strong> - Genomics-assisted Breeding for High Yielding and Climate Resilient Pigeonpea Varieties/Hybrids and Promotion Promotion of Best Suitable Cultivars for Food and Nutritional Security in Karnataka State in India</td>
<td>ICRISAT</td>
<td>18,000</td>
<td>Government of Karnataka</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP4</td>
<td>15% - Introduction and Expansion of Improved Pigeonpea (Arhar) Production Technology (IPPT) in Rainfed Upland Ecosystems of Odisha</td>
<td>ICRISAT</td>
<td>5,850</td>
<td>Government of Odisha, India</td>
<td></td>
</tr>
<tr>
<td>---------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------</td>
<td>--------</td>
<td>------</td>
<td>---------------------------</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP4</td>
<td>60% - Promotion of Improved Chickpea Varieties in Rice - Based Cropping Systems of Smallholder Farmers in Odisha</td>
<td>ICRISAT</td>
<td>583,800</td>
<td>Government of Odisha, India</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP4</td>
<td>40% - Development of Hybrid Pigeonpea Technology Suitable for Rajasthan</td>
<td>ICRISAT</td>
<td>20,800</td>
<td>Swami Keshwanand Rajasthan Agricultural University, Government of Rajasthan, India</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP4</td>
<td>40% - Enhancing Livelihoods of Resource-poor Farmers of Rajasthan through Introduction of Eco-friendly Pigeonpea Varieties</td>
<td>ICRISAT</td>
<td>91,200</td>
<td>Swami Keshwanand Rajasthan Agricultural University, Government of Rajasthan, India</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP4</td>
<td>50% - Engagement for the Implementation of Production and Processing of New Groundnut Varieties and Improved Cropping System in Nigeria</td>
<td>ICRISAT</td>
<td>44,500</td>
<td>Nigeria</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP4</td>
<td>50% - Popularization of Improved Groundnut Varieties through Seed Production for Increased Agricultural Productivities and Food Security in Northern Nigeria.</td>
<td>ICRISAT</td>
<td>42,500</td>
<td>The West Africa Agricultural Productivity Programme (WAAPP) - Nigeria</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP4</td>
<td>20% - Innovative Communication Media and Methods for More Effective Aflatoxin Mitigation, Variety Uptake, and Use Intervention in Groundnut in Malawi and Tanzania</td>
<td>ICRISAT</td>
<td>2,800</td>
<td>McKnight Foundation</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP4</td>
<td>40% - Collaborate to Increase and Enhance Chickpea and Pigeonpea Production Technologies in the Farmers’ Fields of the Districts of Andhra Pradesh and Karnataka under India Food Legumes Initiative</td>
<td>ICRISAT</td>
<td>197,200</td>
<td>OCP Foundation, Morocco</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP4</td>
<td>30% - Sustainable Intensification of Maize - Legume Cropping Systems for Food Security in Eastern and Southern Africa (SIMLESA)</td>
<td>ICRISAT</td>
<td>114,300</td>
<td>CIMMYT (ACIAR grant)</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP4</td>
<td>40% - Diversification of Pigeonpea Hybrid Parents for Increased Stable Production</td>
<td>ICRISAT</td>
<td>22,400</td>
<td>Seed Companies (Appendix 3)</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP4</td>
<td>20% - Groundnut and Chickpea Varietal Development Research Consortium</td>
<td>ICRISAT</td>
<td>1,200</td>
<td>Seed Companies (Appendix 3)</td>
<td></td>
</tr>
<tr>
<td>Project Description</td>
<td>Funding Organization</td>
<td>Budget</td>
<td>Implementing Organization</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------------------------------------------------------------------------------</td>
<td>----------------------</td>
<td>--------</td>
<td>---------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP4 10% - Evaluation of Pigeonpea Varieties under Various Cropping Systems for Special Purposes Across Locations</td>
<td>ICRISAT 100</td>
<td></td>
<td>Isabela State University, Philippines</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP4 50% - Enhancing Productivity and Competitiveness of Groundnut-based Cropping Systems in Malawi by Developing and Deploying Labor Saving and Drudgery Reducing Technologies in the Groundnut Value Chain</td>
<td>ICRISAT 150,000</td>
<td></td>
<td>McKnight Foundation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP4 70% - Unlocking the Opportunities to Enhance Sustainable Seed Systems of Staple Crops (Sorghum, Pearl Millet, Maize, Cowpea and Groundnut) to Improve Food Security and Agricultural Production in West and Central Africa - (AusAID)</td>
<td>ICRISAT 0</td>
<td></td>
<td>IER, Mali</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP4 100% - Niger Seed Systems Project for Pearl Millet and Legumes</td>
<td>ICRISAT 216,000</td>
<td></td>
<td>McKnight Foundation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP4 100% - Development of high-value-added cowpea varieties, speeding up in their dissemination with a seed production system, and inspection of the system’s effectiveness</td>
<td>Bilateral IITA 987,898</td>
<td></td>
<td>Japan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.1. Research on seed systems &amp; other agro-inputs</td>
<td>CIAT 429,521</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tropical Legumes III: Improving the Livelihoods of Smallholder Farmers: Enhanced Grain Legume Productivity and Production in Sub-Saharan Africa and South Asia (15%); The Pan-African Beans Research Alliance (PABRA (10%)</td>
<td>ICRISAT 600</td>
<td></td>
<td>The Bureau of Agricultural Research, Philippines</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.1. Research on seed systems &amp; other agro-inputs</td>
<td>W3 Bioversity 100,000</td>
<td>IFAD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Linking agrobiodiversity value chains and climate adaptation: empowering the poor to manage risk (IFAD-funded portion)</td>
<td>W3 Bioversity 150,000</td>
<td>UNEP/GEF</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.1. Research on seed systems &amp; other agro-inputs</td>
<td>Bilateral Bioversity 200,000</td>
<td>ICAR</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.2. Scaling out seed technologies</td>
<td>Tropical Legumes III: Improving the Livelihoods of Smallholder Farmers: Enhanced Grain Legume Productivity and Production in Sub-Saharan Africa and South Asia (30%); The Pan-African Beans Research Alliance (PABRA) (20%)</td>
<td>CIAT</td>
<td>859,042</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>-------------------------------------------------------------------------------------------------</td>
<td>------</td>
<td>-------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.2. Scaling out seed technologies</td>
<td><strong>100%</strong> - Taking cowpeas to scale in West Africa (USAID Cowpea Project)</td>
<td>Bilateral</td>
<td>IITA</td>
<td>2,450,000</td>
<td>USAID</td>
</tr>
<tr>
<td>4.2. Scaling out seed technologies</td>
<td><strong>100%</strong> - Making high quality soybean seeds accessible to smallholder farmers in Malawi</td>
<td>Bilateral</td>
<td>IITA</td>
<td>1,019,200</td>
<td>USAID</td>
</tr>
<tr>
<td>4.2. Scaling out seed technologies</td>
<td><strong>50%</strong> - Scaling up Groundnut Technology Diffusion (USAID)</td>
<td>ICRISAT</td>
<td>4,967,000</td>
<td>CGIAR/USAID</td>
<td></td>
</tr>
<tr>
<td>4.2. Scaling out seed technologies</td>
<td>Taking cowpeas to scale in West Africa (USAID Cowpea Project)</td>
<td>IITA</td>
<td>USAID</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.2. Scaling out seed technologies</td>
<td>Making high quality soybean seeds accessible to smallholder farmers in Malawi</td>
<td>IITA</td>
<td>USAID</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.3. Commercial hybrid seed production</td>
<td><strong>60%</strong> - Support for Malawi Seed Industry Development</td>
<td>ICRISAT</td>
<td>190,200</td>
<td>Irish Aid, Ireland</td>
<td></td>
</tr>
<tr>
<td>4.4. Access to prodn inputs</td>
<td></td>
<td></td>
<td>0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Flagship &amp; Clusters of Activities</th>
<th>Related Active Current Bilateral and W3 Project  (Identify only those with a significant link)</th>
<th>Bilateral or W3?</th>
<th>CG Center</th>
<th>Budget US $</th>
<th>Donor</th>
<th>Project Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FP5: Integrated Land, Water &amp; Crop Management</strong></td>
<td><strong>Multiple CoAs in FP5</strong> 50% - Intensification of Maize-Legume based Systems in the Semi-Arid Areas of Tanzania (Kongwa and Kiteto Districts) to Increase Farm Productivity and Improve Farming Natural Resource Base - ( USAID)</td>
<td>W3</td>
<td>ICRISAT</td>
<td>212,000</td>
<td>IITA/USAID</td>
<td>not available</td>
</tr>
<tr>
<td></td>
<td><strong>Multiple CoAs in FP5</strong> 40% - Zambia Aflatoxin Research &amp; Mitigation (USAID)</td>
<td>W3</td>
<td>ICRISAT</td>
<td>13,600</td>
<td>CGIAR/USAID</td>
<td>not available</td>
</tr>
<tr>
<td></td>
<td><strong>Multiple CoAs in FP5</strong> 30% - Reseeding Malawi’s Smallholder Agriculture (USAID)</td>
<td>W3</td>
<td>ICRISAT</td>
<td>855,300</td>
<td>CGIAR/USAID</td>
<td>not available</td>
</tr>
<tr>
<td></td>
<td><strong>Multiple CoAs in FP5</strong> 20% - Scaling up Groundnut Technology Diffusion (USAID)</td>
<td>W3</td>
<td>ICRISAT</td>
<td>587,600</td>
<td>CGIAR/USAID</td>
<td>not available</td>
</tr>
<tr>
<td></td>
<td><strong>Multiple CoAs in FP5</strong> 50% - Improving Soil Fertility, Productivity and Livelihoods of Smallholder Farmers in Tanzania through Intensification and Diversification of Pigeonpea Cropping Systems - (Alliance for a Green Revolution in Africa - AGRA)</td>
<td>ICRISAT</td>
<td>11,000</td>
<td>SARI, Tanzania</td>
<td>not available</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Multiple CoAs in FP5</strong> 50% - Improving Soil Fertility Productivity and Livelihoods of Smallholder Farmers in Northern Uganda by Intensifying Diversification of Pigeonpea Cropping Systems</td>
<td>ICRISAT</td>
<td>55,000</td>
<td>Alliance for a Green Revolution in Africa (AGRA)</td>
<td>not available</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Multiple CoAs in FP5</strong> 50% - Increasing Productivity of Legume-Based Farming Systems in the Central Dry Zone of Myanmar Project</td>
<td>W3</td>
<td>ICRISAT</td>
<td>47,500</td>
<td>ACIAR, Australia</td>
<td>not available</td>
</tr>
<tr>
<td></td>
<td><strong>Multiple CoAs in FP5</strong> 30% - Food legumes for enhanced food and nutritional security, systems productivity and profitability of smallholder farmers in Ethiopia and Uganda”</td>
<td>ICRISAT</td>
<td>29,100</td>
<td>Austrian Development Agency (ADA), Austria</td>
<td>not available</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Multiple CoAs in FP5</strong> 60% - Sustainable Management of Crop-based Production Systems for Raising Agricultural Productivity in Rainfed Asia</td>
<td>W3</td>
<td>ICRISAT</td>
<td>288,600</td>
<td>IFAD</td>
<td>not available</td>
</tr>
<tr>
<td>Multiple CoAs in FP5</td>
<td>10% - Development of Actinomycetes based Metabolites as Delivery Systems for Soil, Health Management in Groundnut (Arachis Hypogaea L.)</td>
<td>ICRISAT</td>
<td>1,400</td>
<td>Department of Biotechnology, India (thru Biotech Consortium India Limited)</td>
<td>not available</td>
<td></td>
</tr>
<tr>
<td>---------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------</td>
<td>--------</td>
<td>------</td>
<td>---------------------------------------------------------------------</td>
<td>---------------</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP5</td>
<td>10% - DST-ICRISAT Center of Excellence (CoE) on Climate Change Research for Plant Protection (CCRPP)</td>
<td>ICRISAT</td>
<td>4,700</td>
<td>Department of Science and Technology, India</td>
<td>not available</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP5</td>
<td>10% - Characterization of Defensive Insectidal Proteins (lectins and serpins) from Plants for Deployment in Transgenic Crops Controlling Cotton Bollworm, Helicoverpa armigera</td>
<td>ICRISAT</td>
<td>900</td>
<td>Department of Science and Technology (thru Science and Engineering Research Board (SERB), India</td>
<td>not available</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP5</td>
<td>10% - Assessment of Actinomycetes as Tripatrite Agent: Biocontrol of Botrytis Grey Mold, Host-Plant Resistance Enhancer and Growth Promoter on Chickpea (Cicer Arietinum L.)</td>
<td>ICRISAT</td>
<td>3,100</td>
<td>Department of Science and Technology (thru Science and Engineering Research Board (SERB), India</td>
<td>not available</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP5</td>
<td>10% - Genomics-assisted Breeding for High Yielding and Climate Resilient Pigeonpea Varieties/Hybrids and Promotion Promotion of Best Suitable Cultivars for Food and Nutritional Security in Karnataka State in India</td>
<td>ICRISAT</td>
<td>6,000</td>
<td>Government of Karnataka</td>
<td>not available</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP5</td>
<td>5% - Introduction and Expansion of Improved Pigeonpea (Arhar) Production Technology (IPPT) in Rainfed Upland Ecosystems of Odisha</td>
<td>ICRISAT</td>
<td>1,950</td>
<td>Government of Odisha, India</td>
<td>not available</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP5</td>
<td>30% - Promotion of Improved Chickpea Varieties in Rice - Based Cropping Systems of Smallholder Farmers in Odisha</td>
<td>ICRISAT</td>
<td>77,400</td>
<td>Government of Odisha, India</td>
<td>not available</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP5</td>
<td>20% - Development of Hybrid Pigeonpea Technology Suitable for Rajasthan</td>
<td>ICRISAT</td>
<td>5,600</td>
<td>Swami Keshwanand Rajasthan Agricultural University, Government of Rajasthan, India</td>
<td>not available</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP5</td>
<td>20% - Enhancing Livelihoods of Resource-poor Farmers of Rajasthan through Introduction of Eco-friendly Pigeonpea Varieties</td>
<td>ICRISAT</td>
<td>26,400</td>
<td>Swami Keshwanand Rajasthan Agricultural University, Government of Rajasthan, India</td>
<td>not available</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP5</td>
<td>20% - Support for Malawi Seed Industry Development</td>
<td>ICRISAT</td>
<td>63,400</td>
<td>Irish Aid, Ireland</td>
<td>not available</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP5</td>
<td>10% - Engagement for the Implementation of Production and Processing of New Groundnut Varieties and Improved Cropping System in Nigeria</td>
<td>ICRISAT</td>
<td>8,900</td>
<td>Nigeria</td>
<td>not available</td>
<td></td>
</tr>
<tr>
<td>---------------------------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
<td>---------</td>
<td>-------</td>
<td>----------</td>
<td>---------</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP5</td>
<td>20% - Popularization of Improved Groundnut Varieties through Seed Production for Increased Agricultural Productivities and Food Security in Northern Nigeria.</td>
<td>ICRISAT</td>
<td>17,000</td>
<td>The West Africa Agricultural Productivity Programme (WAAPP) - Nigeria</td>
<td>not available</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP5</td>
<td>20% - Collaborate to Increase and Enhance Chickpea and Pigeonpea Production Technologies in the Farmers' Fields of the Districts of Andhra Pradesh and Karnataka under India Food Legumes Initiative</td>
<td>ICRISAT</td>
<td>38,600</td>
<td>OCP Foundation, Morocco</td>
<td>not available</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP5</td>
<td>30% - Sustainable Intensification of Maize - Legume Cropping Systems for Food Security in Eastern and Southern Africa (SIMLESA)</td>
<td>ICRISAT</td>
<td>114,300</td>
<td>CIMMYT (ACIAR grant)</td>
<td>not available</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP5</td>
<td>20% - Diversification of Pigeonpea Hybrid Parents for Increased Stable Production</td>
<td>ICRISAT</td>
<td>2,800</td>
<td>Seed Companies (Appendix 3)</td>
<td>not available</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP5</td>
<td>10% - Benchmarking of Traits Controlling the Plant Water Budget in Orphan Legumes</td>
<td>ICRISAT</td>
<td>7,600</td>
<td>Kirkhouse Trust, UK</td>
<td>not available</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP5</td>
<td>20% - Aflatoxin Management Interventions, Education, and Analysis at Various Steps within the Peanut Value Chain in Malawi, Mozambique and Zambia</td>
<td>ICRISAT</td>
<td>3,800</td>
<td>North Carolina University (NCSU), USA</td>
<td>not available</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP5</td>
<td>30% - Global Hunger and Food Security Research Strategy : Climate Resilience, Nutrition, and Policy - Feed the Future Innovation Lab for Climate Resilient Chickpea</td>
<td>ICRISAT</td>
<td>58,800</td>
<td>The Regents of the University of California</td>
<td>not available</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP5</td>
<td>30% - New Varieties and Management Systems to Improve Productivity, Food Security and Safety and Market Competitiveness</td>
<td>ICRISAT</td>
<td>60,000</td>
<td>McKnight Foundation</td>
<td>not available</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP5</td>
<td>10% - Enhancing Productivity and Competitiveness of Groundnut-based Cropping Systems in Malawi by Developing and Deploying Labor Saving and Drudgery Reducing Technologies in the Groundnut Value Chain</td>
<td>ICRISAT</td>
<td>9,500</td>
<td>McKnight Foundation</td>
<td>not available</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP5</td>
<td>W3 Russian Funding- Establishing Strategic Innovation Platform for multi-stakeholder process</td>
<td>W3 ICARDA</td>
<td>35,000</td>
<td>Russia</td>
<td>not available</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FPS</td>
<td>W3 Russian Funding- Establish a seed systems platform compatible with existing agro-ecological environments to supply farmers with high quality seed and planting materials so as to improve livelihoods, food security and incomes of smallholders</td>
<td>W3</td>
<td>ICARDA</td>
<td>139,000</td>
<td>Russia</td>
<td>not available</td>
</tr>
<tr>
<td>---------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-----</td>
<td>-------</td>
<td>--------</td>
<td>--------</td>
<td>----------------</td>
</tr>
<tr>
<td>Multiple CoAs in FPS</td>
<td>ICRAF has an interest/involvement, links to WLSE, FTA (Jan, Edmundo, Ingrid, Keith, etc.)</td>
<td>Bilateral</td>
<td>ICRAF</td>
<td></td>
<td></td>
<td>Netherlands</td>
</tr>
<tr>
<td>5.1. Water and land allocation &amp; conservation</td>
<td>Sustainable Intensification of Key Farming Systems in the Sudano-Sahelian Zone of West Africa</td>
<td>W3</td>
<td>IWMI</td>
<td>110,000</td>
<td>USAID</td>
<td></td>
</tr>
<tr>
<td>5.1. Water and land allocation &amp; conservation</td>
<td>Strengthening Bhoochetana Sustainable Agriculture Mission for Improved Livelihoods in Karnataka</td>
<td>Bilateral</td>
<td>ICRISAT</td>
<td>$4.6m pa</td>
<td>Govt. of Karnataka</td>
<td></td>
</tr>
<tr>
<td>5.2. Sustainable land management, restoration &amp; Carbon sequestration</td>
<td>Restoration of degraded lands: taking successes in land restoration to scale.</td>
<td>W3</td>
<td>ICRISAT-ICARDA-ILRI</td>
<td>1.23 million $US (Full grant $6.35m)</td>
<td>EU/IFAD</td>
<td>The goal of the project is to reduce food insecurity and improve livelihoods of poor people living in African drylands by restoring degraded land, and returning it to effective and sustainable tree, crop and livestock production, thereby increasing land profitability and landscape and livelihood resilience.</td>
</tr>
<tr>
<td>5.3. Integrated soil-crop-water-nutrient management</td>
<td>Enhancing nutrition, stepping up resilience and enterprise. ENSURE</td>
<td>Bilateral</td>
<td>ICRISAT</td>
<td>2 m (2013-2018)</td>
<td>USAID through World Vision Zimbabwe</td>
<td>ICRISAT’s contribution to this project is restricted to the agricultural development component of this larger project. Specific objectives: Establish demonstration plots that illustrate integrated and intensified crop livestock systems. Train farmers and extension workers on integrated cereal, legume livestock systems using fodder legumes, groundnuts and sorghum. Provide backstopping to the development of functional value chains for both groundnuts and livestock.</td>
</tr>
<tr>
<td>-------------------------------------------------</td>
<td>---------------------------------------------------------------</td>
<td>----------</td>
<td>--------</td>
<td>-----------------</td>
<td>-----------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>5.3. Integrated soil-crop-water-nutrient management</td>
<td>Achieving sustainable Striga control for poor farmers in Africa (BMGF)</td>
<td>W3</td>
<td>IITA</td>
<td>BMGF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.3. Integrated soil-crop-water-nutrient management</td>
<td>100% - Putting Nitrogen Fixation to Work for Smallholder Farmers in Africa (N2Africa) Phase II</td>
<td>Bilateral</td>
<td>IITA</td>
<td>BMGF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.4. Cropping pattern, sequence and management</td>
<td>Increasing agricultural productivity and incomes through bridging yield gaps with science-led interventions in Karnataka (Bhuchetana)</td>
<td>Bilateral</td>
<td>ICRISAT</td>
<td>0.684/year (2013-16)</td>
<td>Govt of Karnataka</td>
<td>To operationalize an integrated and participatory knowledge-led farming systems development approach for increasing agricultural productivity for sustainably improving the livelihoods of the farmers through empowerment, capacity development with knowledge-based and market oriented farmers’ centric partnership approach</td>
</tr>
<tr>
<td>5.5. Mechanization of farm operations</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.6. Sustainable management of biotic stresses</td>
<td>Integrating traditional crop genetic diversity into technology: using a biodiversity portfolio approach to buffer against unpredictable environmental change in the Nepal Himalayas</td>
<td>Bilateral</td>
<td>Bioversity</td>
<td>1,500,000</td>
<td>UNEP/GEF</td>
<td></td>
</tr>
<tr>
<td>5.6. Sustainable management of biotic stresses</td>
<td>100% - Planning Grant for the Development and Delivery of Sustainable Integrated Pest Management Strategies in Cowpea for West Africa (MSU)</td>
<td>Bilateral</td>
<td>IITA</td>
<td>505,248</td>
<td>BMGF</td>
<td></td>
</tr>
<tr>
<td>5.6. Sustainable management of biotic stresses</td>
<td>100% Enhancing soybean productivity through rapid diagnostics for soybean rust and determining pathogenic diversity to enhance resistance breeding in eastern Africa.</td>
<td>Bilateral</td>
<td>IITA</td>
<td>67,800</td>
<td>FUNARBE</td>
<td></td>
</tr>
<tr>
<td>5.6. Sustainable management of biotic stresses</td>
<td>100% - Sustainable Cowpea production for rural smallholder farmers in Nigeria through Integrated Pest Management approach (PEARL)</td>
<td>Bilateral</td>
<td>IITA</td>
<td>114,679</td>
<td>BMGF</td>
<td></td>
</tr>
<tr>
<td>5.6. Sustainable management of biotic stresses</td>
<td>100% - Biological Foundations of Management of Field Insect Pests of Cowpea in West Africa (Univ Illinois)</td>
<td>Bilateral</td>
<td>IITA</td>
<td>203,070</td>
<td>USIAD</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Flagship &amp; Clusters of Activities</th>
<th>Related Active Current Bilateral and W3 Project (Identify only those with a significant link)</th>
<th>Bilateral or W3?</th>
<th>CG Center</th>
<th>Budget US $</th>
<th>Donor</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FP6: Improved Rural Livelihood Systems</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP6</td>
<td><strong>20%</strong> - Reseeding Malawi's Smallholder Agriculture (USAID)</td>
<td>W3</td>
<td>ICRISAT</td>
<td>570,200</td>
<td>CGIAR/USAID</td>
</tr>
<tr>
<td>Multiple CoAs in FP6</td>
<td><strong>30%</strong> - Scaling up Groundnut Technology Diffusion (USAID)</td>
<td>W3</td>
<td>ICRISAT</td>
<td>881,400</td>
<td>CGIAR/USAID</td>
</tr>
<tr>
<td>Multiple CoAs in FP6</td>
<td><strong>10%</strong> - Development of Hybrid Pigeonpea Technology Suitable for Rajasthan</td>
<td></td>
<td></td>
<td></td>
<td>Swami Keshwanand Rajasthan Agricultural University, Government of Rajasthan, India</td>
</tr>
<tr>
<td>Multiple CoAs in FP6</td>
<td><strong>10%</strong> - Enhancing Livelihoods of Resource-poor Farmers of Rajasthan through Introduction of Eco-friendly Pigeonpea Varieties</td>
<td></td>
<td></td>
<td></td>
<td>Swami Keshwanand Rajasthan Agricultural University, Government of Rajasthan, India</td>
</tr>
<tr>
<td>Multiple CoAs in FP6</td>
<td><strong>20%</strong> - Support for Malawi Seed Industry Development</td>
<td></td>
<td>ICRISAT</td>
<td>63,400</td>
<td>Irish Aid, Ireland</td>
</tr>
<tr>
<td>Multiple CoAs in FP6</td>
<td><strong>30%</strong> - Engagement for the Implementation of Production and Processing of New Groundnut Varieties and Improved Cropping System in Nigeria</td>
<td></td>
<td>ICRISAT</td>
<td>26,700</td>
<td>Nigeria</td>
</tr>
<tr>
<td>Multiple CoAs in FP6</td>
<td><strong>20%</strong> - Popularization of Improved Groundnut Varieties through Seed Production for Increased Agricultural Productivities and Food Security in Northern Nigeria.</td>
<td></td>
<td>ICRISAT</td>
<td>17,000</td>
<td>The West Africa Agricultural Productivity Programme (WAAPP) - Nigeria</td>
</tr>
<tr>
<td>Multiple CoAs in FP6</td>
<td><strong>20%</strong> - Innovative Communication Media and Methods for More Effective Aflatoxin Mitigation, Variety Uptake, and Use Intervention in Groundnut in Malawi and Tanzania</td>
<td></td>
<td>ICRISAT</td>
<td>2,800</td>
<td>McKnight Foundation</td>
</tr>
<tr>
<td>Multiple CoAs in FP6</td>
<td><strong>10%</strong> - Collaborate to Increase and Enhance Chickpea and Pigeonpea Production Technologies in the Farmers’ Fields of the Districts of Andhra Pradesh and Karnataka under India Food Legumes Initiative</td>
<td></td>
<td>ICRISAT</td>
<td>19,300</td>
<td>OCP Foundation, Morocco</td>
</tr>
<tr>
<td>Multiple CoAs in FP6</td>
<td><strong>10%</strong> - Sustainable Intensification of Maize - Legume Cropping Systems for Food Security in Eastern and Southern Africa (SIMLESA)</td>
<td>W3</td>
<td>ICRISAT</td>
<td>38,100</td>
<td>CIMMYT (ACIAR grant)</td>
</tr>
<tr>
<td>Multiple CoAs in FP6</td>
<td><strong>10%</strong> - Diversification of Pigeonpea Hybrid Parents for Increased Stable Production</td>
<td></td>
<td>ICRISAT</td>
<td>1,400</td>
<td>Seed Companies (Appendix 3)</td>
</tr>
<tr>
<td>Multiple CoAs in FP6</td>
<td>50% - New Varieties and Management Systems to Improve Productivity, Food Security and Safety and Market Competitiveness</td>
<td>ICRISAT 100,000</td>
<td>McKnight Foundation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------</td>
<td>----------------</td>
<td>-------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP6</td>
<td>20% - Enhancing Productivity and Competitiveness of Groundnut-based Cropping Systems in Malawi by Developing and Deploying Labor Saving and Drudgery Reducing Technologies in the Groundnut Value Chain</td>
<td>ICRISAT 19,000</td>
<td>McKnight Foundation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP6</td>
<td>20% - Unlocking the Opportunities to Enhance Sustainable Seed Systems of Staple Crops (Sorghum, Pearl Millet, Maize, Cowpea and Groundnut) to Improve Food Security and Agricultural Production in West and Central Africa - (AusAID)</td>
<td>ICRISAT 0</td>
<td>IER, Mali</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP6</td>
<td>W3 Russian Funding- Improve water use efficiency through innovative technologies in irrigation and farming in cereals, potato, vegetable, horticultural and fodder crops.</td>
<td>W3 ICARDA 43,120</td>
<td>Russia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP6</td>
<td>W3 Russian Funding- Bio-economic modeling of farming systems, technological options for natural resource management under different scenarios of the state of natural resource base, market conditions and policies for determining optimal use of resources, and assessing the economic, social and environmental consequences on target population</td>
<td>W3 ICARDA 49,000</td>
<td>Russia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP6</td>
<td>Water Productivity India</td>
<td>W3 ICARDA 59,491</td>
<td>Other</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP6</td>
<td>Optimizing On-farm Water and Land Productivity in Irrigated Agriculture in Egypt</td>
<td>Bilateral ICARDA 71,383</td>
<td>Other</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP6</td>
<td>W3 Russian Funding- Evaluate the effect of conjunctive use of canal and drainage waters</td>
<td>W3 ICARDA 73,500</td>
<td>Russia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP6</td>
<td>Middle East North Africa Water and Livelihoods Initiative (WLI) - Tunisia</td>
<td>W3 ICARDA 94,965</td>
<td>USAID</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP6</td>
<td>An Assessment of the Economics of Land Degradation for Improved Land Management in Central Asia</td>
<td>Bilateral ICARDA 100,000</td>
<td>GIZ</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP6</td>
<td>Proposed Jalalpur Irrigation Project, Pakistan. Project Preparatory Technical Assistance</td>
<td>Bilateral ICARDA 102,005</td>
<td>Other</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP6</td>
<td>On-farm Conservation and Mining of Local Faba Bean Landraces of Morocco for Biotic and Abiotic stresses</td>
<td>Bilateral ICARDA 103,687</td>
<td>Other</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CoAs in FP6</td>
<td>Project Description</td>
<td>Implementing Agency</td>
<td>Funding</td>
<td>Funding Agency</td>
<td></td>
</tr>
<tr>
<td>------------</td>
<td>---------------------</td>
<td>---------------------</td>
<td>---------</td>
<td>---------------</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP6</td>
<td>Middle East North Africa Water and Livelihoods Initiative (WLI)-Regional</td>
<td>W3</td>
<td>ICARDA</td>
<td>USAID</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP6</td>
<td>Adaptation to Climate Change of the Mediterranean Agricultural Systems – ACLIMAS</td>
<td>Bilateral</td>
<td>ICARDA</td>
<td>EU/EC</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP6</td>
<td>Management of Water and Salinity in the Nile Delta: a cross-scale integrated analysis of efficiency and equity issues</td>
<td>Bilateral</td>
<td>ICARDA</td>
<td>AusAID/ACIAR</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP6</td>
<td>Integrated Agricultural Production Systems for the poor and vulnerable in Dryland Areas: Nile Valley and Sub-Saharan Africa Region</td>
<td>W3</td>
<td>ICARDA</td>
<td>IFAD</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP6</td>
<td>Improving soil fertility and soil health in Pakistan through demonstration and dissemination of best management practices for farmers</td>
<td>Bilateral</td>
<td>ICARDA</td>
<td>USAID</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP6</td>
<td>Watershed Rehabilitation and Irrigation Improvement: Demonstrating in Pakistan and disseminating the Best Technologies to Help Rural Farmers</td>
<td>Bilateral</td>
<td>ICARDA</td>
<td>USAID</td>
<td></td>
</tr>
</tbody>
</table>

6.1. System-specific ex ante analysis and prioritization
The Pan-African Beans Research Alliance (PABRA) (5%)
CIAT
100,000

6.2. Testing, adaptation and validation of options

6.3. Implications of scaling across landscapes
Integrating crop and livestock production for improved food security and livelihoods in rural Zimbabwe
W3
ICRISAT (ILRI Lead)
0.2 (2016-17) ICRISAT component only.
ACIAR

6.3. Implications of scaling across landscapes
Integrating crop and livestock for improved food security and livelihoods in rural Zimbabwe
W3
ILRI
$3,482,000
ACIAR

6.3. Implications of scaling across landscapes
Agricultural Innovation Program (Pakistan)
W3
ILRI
$5,665,000
USAID

6.3. Implications of scaling across landscapes
Improving Rural Livelihoods through Innovative Scaling up of Science led participatory Research for Development in Karnataka
W3
ILRI
$200,000
Government of Karnataka
<p>| 6.3. Implications of scaling across landscapes | Use and conservation of agrobiodiversity for increased agricultural sustainability, smallholder wellbeing and resilience to climate change in India | W3 | Bioversity | 320,000 | ICAR |
| 6.3. Implications of scaling across landscapes | 40% - Sustainable Intensification of Maize-Legume Systems for the Eastern Province of Zambia (SIMLEZA) (USAID) | bilateral | IITA | 946,492 | USAID |
| 6.3. Implications of scaling across landscapes | Africa RISING: Impact of Sustainable Intensification on Landscapes and Livelihoods (Africa RISING Global Climate Change Mitigation) (USAID) | IITA | USAID |
| 6.3. Implications of scaling across landscapes | 30% - Sustainable Intensification of Key Farming Systems in the Sudano-Sahelian Zone of West Africa (USAID) | bilateral | IITA | 270,000 | USAID |
| 6.3. Implications of scaling across landscapes | ICRAF, Local Governance and Adapting to Climate Change in Sub-Saharan Africa (LGACC). | bilateral, 3 years 2015-2017 | ICRAF/ILRI | 500,000 | USAID |
| 6.3. Implications of scaling across landscapes | Mainstreaming agricultural biodiversity conservation and utilization in agricultural sector to ensure ecosystem services and reduce vulnerability | Bilateral | Bioversity | 610,000 | UNEP/GEF |
| 6.5. Enabling environments for widespread adoption | 50% - The USAID-funded Zambia feed the future research and development program coordination unit | W3 | IITA | 540,839 | USAID |
| 6.5. Enabling environments for widespread adoption | Increasing agricultural productivity and incomes through bridging yield gaps with science-led interventions in Karnataka (Bhuchetana) | Bilateral | ICRISAT | 0.684 (2016) | Government of Karnataka |
| 6.5. Enabling environments for widespread adoption | Africa Rising | W3 | ICRISAT | 0.7m 2016 | USAID |</p>
<table>
<thead>
<tr>
<th>Flagship &amp; Clusters of Activities</th>
<th>Related Active Current Bilateral and W3 Project (Identify only those with a significant link)</th>
<th>Bilateral or W3?</th>
<th>CG Center</th>
<th>Budget US $</th>
<th>Donor</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FP7: Post-harvest Value &amp; Output Markets</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP7</td>
<td>10% - Biofortification of Long Chain Polyunsaturated Fatty Acids in Peanut by Metabolic Engineering of Fatty Acid Biosynthetic Pathway</td>
<td>Bilateral</td>
<td>ICRISAT</td>
<td>1,900</td>
<td>Department of Biotechnology, India</td>
</tr>
<tr>
<td>Multiple CoAs in FP7</td>
<td>10% - Development of Hybrid Pigeonpea Technology Suitable for Rajasthan</td>
<td>Bilateral</td>
<td>ICRISAT</td>
<td>2,800</td>
<td>Swami Keshwanand Rajasthan Agricultural University, Government of Rajasthan, India</td>
</tr>
<tr>
<td>Multiple CoAs in FP7</td>
<td>10% - Enhancing Livelihoods of Resource-poor Farmers of Rajasthan through Introduction of Eco-friendly Pigeonpea Varieties</td>
<td>Bilateral</td>
<td>ICRISAT</td>
<td>13,200</td>
<td>Swami Keshwanand Rajasthan Agricultural University, Government of Rajasthan, India</td>
</tr>
<tr>
<td>Multiple CoAs in FP7</td>
<td>10% - Engagement for the Implementation of Production and Processing of New Groundnut Varieties and Improved Cropping System in Nigeria</td>
<td>Bilateral</td>
<td>ICRISAT</td>
<td>8,900</td>
<td>Nigeria</td>
</tr>
<tr>
<td>Multiple CoAs in FP7</td>
<td>10% - Popularization of Improved Groundnut Varieties through Seed Production for Increased Agricultural Productivities and Food Security in Northern Nigeria.</td>
<td>Bilateral</td>
<td>ICRISAT</td>
<td>8,500</td>
<td>The West Africa Agricultural Productivity Programme (WAAPP) - Nigeria</td>
</tr>
<tr>
<td>Multiple CoAs in FP7</td>
<td>10% - Innovative Communication Media and Methods for More Effective Aflatoxin Mitigation, Variety Uptake, and Use Intervention in Groundnut in Malawi and Tanzania</td>
<td>Bilateral</td>
<td>ICRISAT</td>
<td>1,400</td>
<td>McKnight Foundation</td>
</tr>
<tr>
<td>Multiple CoAs in FP7</td>
<td>10% - Collaborate to Increase and Enhance Chickpea and Pigeonpea Production Technologies in the Farmers’ Fields of the Districts of Andhra Pradesh and Karnataka under India Food Legumes Initiative</td>
<td>Bilateral</td>
<td>ICRISAT</td>
<td>19,300</td>
<td>OCP Foundation, Morocco</td>
</tr>
<tr>
<td>Multiple CoAs in FP7</td>
<td>10% - Diversification of Pigeonpea Hybrid Parents for Increased Stable Production</td>
<td>Bilateral</td>
<td>ICRISAT</td>
<td>1,400</td>
<td>Seed Companies (Appendix 3)</td>
</tr>
<tr>
<td>Multiple CoAs in FP7</td>
<td>50% - Groundnut and Chickpea Varietal Development Research Consortium</td>
<td>Bilateral</td>
<td>ICRISAT</td>
<td>3,000</td>
<td>Seed Companies (Appendix 3)</td>
</tr>
<tr>
<td>Multiple CoAs in FP7</td>
<td>30% - Aflatoxin Management Interventions, Education, and Analysis at Various Steps within the Peanut Value Chain in Malawi, Mozambique and Zambia</td>
<td>Bilateral</td>
<td>ICRISAT</td>
<td>5,700</td>
<td>North Carolina University (NCSU), USA</td>
</tr>
<tr>
<td>Multiple CoAs in FP7</td>
<td>20% - New Varieties and Management Systems to Improve Productivity, Food Security and Safety and Market Competitiveness</td>
<td>ICRISAT</td>
<td>40,000</td>
<td>McKnight Foundation</td>
<td></td>
</tr>
<tr>
<td>---------------------</td>
<td>-------------------------------------------------------------------------------------------------</td>
<td>---------</td>
<td>--------</td>
<td>---------------------</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP7</td>
<td>10% - Enhancing Productivity and Competitiveness of Groundnut-based Cropping Systems in Malawi by Developing and Deploying Labor Saving and Drudgery Reducing Technologies in the Groundnut Value Chain</td>
<td>ICRISAT</td>
<td>9,500</td>
<td>McKnight Foundation</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP7</td>
<td>10% - Improving Widely Grown Groundnut Cultivars by Introgressing Genes for Resistance to Foliar Fungal Diseases (LLS and rust) and High Oil Quality (O/L ratio)</td>
<td>ICRISAT</td>
<td>28,100</td>
<td>MARS, USA</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP7</td>
<td>100% - Implementation Phase of the Universities, Business and Research in Agricultural Innovation (UniBRAIN) Project</td>
<td>ICRISAT</td>
<td>308,500</td>
<td>FARA, Ghana</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP7</td>
<td>10% - Unlocking the Opportunities to Enhance Sustainable Seed Systems of Staple Crops (Sorghum, Pearl Millet, Maize, Cowpea and Groundnut) to Improve Food Security and Agricultural Production in West and Central Africa - (AusAID)</td>
<td>ICRISAT</td>
<td>0</td>
<td>IER, Mali</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP7</td>
<td>100% - Selection of Implementing Agency (IA) for Setting up 5 (Five) Numbers of Food Testing Laboratories (FTLs) in Africa under IAFS-II.</td>
<td>ICRISAT</td>
<td>275,500</td>
<td>Ministry of Food Processing Industries, Government of India (MoFPI)</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP7</td>
<td>100% - Selection of Implementing Agency (IA) for Setting up of 5 (Five) Numbers of Food Processing Business Incubation Centers (FPBICs) in Africa under IAFS-II.</td>
<td>ICRISAT</td>
<td>112,500</td>
<td>Ministry of Food Processing Industries, Government of India (MoFPI)</td>
<td></td>
</tr>
<tr>
<td>Multiple CoAs in FP7</td>
<td>USAID GLOBAL CLIMATE CHANGE (USAID GCC)</td>
<td>W3</td>
<td>ICRISAT</td>
<td>1 m annually (2015-2016) but negotiating extension post 2016</td>
<td>USAID</td>
</tr>
<tr>
<td>Multiple CoAs in FP7</td>
<td>Integrated Natural Resources Management in Rainfed Agricultural Systems in Morocco (INRM)</td>
<td>Bilateral</td>
<td>ICARDA</td>
<td>30,000</td>
<td>Other</td>
</tr>
<tr>
<td>Multiple CoAs in FP7</td>
<td>Improving Small Ruminant Productivity and Integrating Crop-Livestock System and Rangeland Management</td>
<td>W3</td>
<td>ICARDA</td>
<td>47,223</td>
<td>Other</td>
</tr>
<tr>
<td>Multiple CoAs in FP7</td>
<td>Optimizing Subsidiary Crop Applications in Rotations (OSCAR)</td>
<td>Bilateral</td>
<td>ICARDA</td>
<td>62,191</td>
<td>EU/EC</td>
</tr>
<tr>
<td>Multiple CoAs in FP7</td>
<td>Project Description</td>
<td>Funding Agency</td>
<td>Amount</td>
<td>Partner</td>
<td></td>
</tr>
<tr>
<td>---------------------</td>
<td>---------------------</td>
<td>----------------</td>
<td>--------</td>
<td>---------</td>
<td></td>
</tr>
<tr>
<td><strong>Enhancing Sustainability and Fodder Production of Low Land Pastures through integrated Aley Cropping and Conservation Agriculture in Arid Agro-Pastoral Ecosystems in Jordan, Yemen and Tunisia</strong></td>
<td>Multiple CoAs in FP7</td>
<td>ICARDA</td>
<td>85,382</td>
<td>Other</td>
<td></td>
</tr>
<tr>
<td><strong>W3 Russian Funding: Improve the productivity of marginal lands in irrigated farming and pastoral systems</strong></td>
<td>Multiple CoAs in FP7</td>
<td>ICARDA</td>
<td>100,000</td>
<td>Russia</td>
<td></td>
</tr>
<tr>
<td><strong>Strengthening Livestock Holders’ livelihood in area C (Rawasi)</strong></td>
<td>Multiple CoAs in FP7</td>
<td>ICARDA</td>
<td>110,242</td>
<td>Other</td>
<td></td>
</tr>
<tr>
<td><strong>Development of Conservation Cropping Systems in the Dryland of Northern Iraq - Phase 3</strong></td>
<td>Multiple CoAs in FP7</td>
<td>ICARDA</td>
<td>172,909</td>
<td>AusAID/ACIAR</td>
<td></td>
</tr>
<tr>
<td><strong>W3 Russian Funding: Increase livestock productivity to improve availability of animal proteins to the households and increased revenues and wellbeing of the pastoralists</strong></td>
<td>Multiple CoAs in FP7</td>
<td>ICARDA</td>
<td>189,000</td>
<td>Russia</td>
<td></td>
</tr>
<tr>
<td><strong>AIP Pakistan: Development of Small Ruminant Value Chains and Feed Resources &amp; Rangeland assessment and management</strong></td>
<td>Multiple CoAs in FP7</td>
<td>ICARDA</td>
<td>266,758</td>
<td>USAID</td>
<td></td>
</tr>
<tr>
<td><strong>Scaling-up Pulse Innovations for Nutrition Security in Southern Ethiopia</strong></td>
<td>Multiple CoAs in FP7</td>
<td>ICRISAT</td>
<td>0.3 m Canadian Dollars (03.2015-02.2018) (Grant 1m/year total all partners)</td>
<td>IDRC Canada through University of Saskatchewan</td>
<td></td>
</tr>
<tr>
<td><strong>30% - National First 1000 Most Critical Days Programme</strong></td>
<td>Multiple CoAs in FP7</td>
<td>IITA</td>
<td>169,570</td>
<td>CARE/Zambia</td>
<td></td>
</tr>
<tr>
<td><strong>100% - USAID Soybean Innovation Laboratory - Human Nutrition Sub award</strong></td>
<td>Multiple CoAs in FP7</td>
<td>IITA</td>
<td>184,938</td>
<td>USAID</td>
<td></td>
</tr>
<tr>
<td><strong>100% - public-private partnership for innovation in soybean and cowpea value chains in Mozambique (Platform Mozambique)(USAID)</strong></td>
<td>Multiple CoAs in FP7</td>
<td>IITA</td>
<td>972,560</td>
<td>USAID</td>
<td></td>
</tr>
<tr>
<td><strong>The Pan-African Beans Research Alliance (PABRA) (15%); Enhancing food and nutrition security and income generation through post-harvest value addition: A case of precooked beans (50%)</strong></td>
<td>Multiple CoAs in FP7</td>
<td>CIAT</td>
<td>872,560</td>
<td>CIAT</td>
<td></td>
</tr>
</tbody>
</table>

**6.2. Improved post-harvest handling and storage**

| **Scaling-up Pulse Innovations for Nutrition Security in Southern Ethiopia** | Multiple CoAs in FP7 | ICRISAT | 0.3 m Canadian Dollars (03.2015-02.2018) (Grant 1m/year total all partners) | IDRC Canada through University of Saskatchewan |
| **30% - National First 1000 Most Critical Days Programme** | Multiple CoAs in FP7 | IITA | 169,570 | CARE/Zambia |
| **100% - USAID Soybean Innovation Laboratory - Human Nutrition Sub award** | Multiple CoAs in FP7 | IITA | 184,938 | USAID |
| **100% - public-private partnership for innovation in soybean and cowpea value chains in Mozambique (Platform Mozambique)(USAID)** | Multiple CoAs in FP7 | IITA | 972,560 | USAID |
| **The Pan-African Beans Research Alliance (PABRA) (15%); Enhancing food and nutrition security and income generation through post-harvest value addition: A case of precooked beans (50%)** | Multiple CoAs in FP7 | CIAT | 872,560 | CIAT |
### Annex 7. PROPOSED CRP-CRP LINKAGES FOR DCLAS

**1. A4NH**

<table>
<thead>
<tr>
<th>DCLAS FP6: Improved Rural Livelihood Systems</th>
<th>Related Activity of Collaborating or Complementary CRP</th>
<th>Name of Collaborating or Complementary CRP</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.1. System-specific ex-ante analyses and prioritization</td>
<td>Characterization of food systems as part of context for household typologies</td>
<td>A4NH FP on Food Systems for Healthy Diets</td>
</tr>
<tr>
<td>6.2. Testing, adaptation and validation of options</td>
<td>Provide a nutrition perspective to interventions, particularly on diversification to modify food systems to improve diets by improving availability and consumption of nutritious foods.</td>
<td>A4NH FP on Food Systems for Healthy Diets</td>
</tr>
<tr>
<td>6.3. Implications of scaling across landscapes</td>
<td>Assess the nutritional implications of interventions at scale</td>
<td>A4NH FP on Food Systems for Healthy Diets</td>
</tr>
</tbody>
</table>

**2. CCAFS**

<table>
<thead>
<tr>
<th>DCLAS Cluster</th>
<th>Related Activity of Collaborating or Complementary CRP</th>
<th>Name of Collaborating or Complementary CRP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FP1: Priority Setting &amp; Impact Acceleration</strong></td>
<td>CCAFS will provide a platform for other CRPs to provide prioritization and ex-ante evaluation backstopping with respect to climate science. Deliverables will include: A range of data maintained on CCAFS and partner websites, including up-to-date downscaled climate information that builds on current CCAFS data portals (e.g. ccafs-climate.org; decision support tools developed and curated by CCAFS and partners for helping to set priorities, target policy development and investment in CSA and climate-smart food systems; Training materials developed and archived in the public domain, to strengthen the capacity of partners in applying decision tools in targeting, policy and investment decision-making.</td>
<td>CCAFS Learning Platform 1 on Ex-ante evaluation and decision support for climate-smart options</td>
</tr>
<tr>
<td><strong>1.1. Foresight, priority setting &amp; learning</strong></td>
<td>CCAFS will provide a cross-AFS-CRP platform for climate-informed breeding. Deliverables will include: improved modelling of climate impacts on specific crops and quantification of uncertainties; next generation GxE models and empirical / big data approaches to understand abiotic constraints affecting different crops and cultivars across climate gradients; improved linkage of genetic, environmental, physiological and agronomic information as a means to mainstream climate information into breeding programs; genotypes identified that have climate-adaptive capacity using historical nursery data, which may have been overlooked for lack of yield potential or other factors (together with DCLAS and other AFS-CRPs).</td>
<td>CCAFS Learning Platform 2 on Foresight, models and metrics for climate-sensitive breeding</td>
</tr>
<tr>
<td><strong>1.3. Climate change analyses</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| FP3: Variety and Hybrid Development | CCAFS will enable testing of varieties within portfolios of "climate-smart" options at field sites (sites shared with other CRPs known in CCAFS as "climate-smart villages") in different biophysical, economic and social contexts to fill gaps in evidence on CSA best bets. Key outputs will include: This CoA will use a range of qualitative and quantitative methods across a broad set of CSVs in different biophysical, economic and social contexts to fill gaps in evidence on CSA best bets. Deliverables will include:  
  - On-farm tested, and evaluated and up-scalable gender-sensitive CSA options such as climate-adapted germplasm, in the context of other options such as agroforestry, water harvesting, livestock nutrition, including transformative options, and models of integrated crop-livestock-tree systems for increasing resilience.  
  - Improved understanding of farmer’s and value chain stakeholder’s perceptions and demands and assessments of the conditions for success and failure of interventions.  
  - Simulation of CSA options under different climate and socio-economic scenarios for informed decision-making.  
  - Empirical and big-data analysis of climate-specific management options, generating climate sensitive extension schemes and site specific advisory systems (including precision agriculture) for farmers.  
  - Policy evidence about novel “farmer citizen science approach” effectiveness for adapting CSA options to the local context, out scaling and engaging extension services and private sector suppliers. | CCAFS Learning Platform 3 on Participatory evaluation of CSA practices and portfolios in CSVs in Africa, Asia, and LAM |
| 3.2. Multi-localational Adaptation Trials |  |

| FP5: Integrated Land, Water & Crop Management | CCAFS will provide a cross-CRP learning platform on smallholder agricultural emissions. Deliverables will include: standard methods and metrics for low emissions development; integrated emission factors and low emissions development opportunities across agri-food systems and regions; analysis of mitigation hotspots and targets to inform center and partner research; policy learning about incentives and finance across countries; and integrated supply chain opportunities for mitigation. | CCAFS Learning Platform 5 on Smallholder agricultural emissions |
| 5.2. Sustainable land management, restoration & Carbon sequestration |  |

| FP6: Improved Rural Livelihood Systems | CCAFS will work with AFS-CRPs on insurance as a component of the enabling environment. Deliverables include: tools and indexes that better cover important risks and raise satisfaction of farmers and insurers, including atlases of risks and triggers for weather index insurance in target countries; science-based schemes for targeting and scaling insurance as an effective risk management option; sustainable public-private partnerships and business models; communications and capacity-building approaches, including South-South learning. | CCAFS Learning Platform 4 on Weather-related agricultural insurance products and programs |
| 6.4. Enabling environments for widespread adoption |  |
6.5. Wider institutional environments
CCAFS will facilitate the uptake of research from DCLAS and other CRPs into climate-smart agriculture policy at national, regional and global levels.

CCAFS Learning Platform 6 on Policy engagement on CSA

3. FTA
Trees are essential components in dryland agriculture and a pre-requisite for sustainable intensification and reducing land degradation in these sensitive environments. FTA covers different agro-ecological zones with 40% of the resources invested in dryland areas where the geographic focus being shared between FTA and DCLAS include East Africa, the Sahel and Central America. From phase 1 there is established collaboration between FTA and Dryland systems within the frame of bilateral projects that will be further develop between DCLAS, FTA and Livestock. Tree based options developed in FTA can be further tested in DCLAS having a broader geographical focus also including Northern Africa and Central Asia. There are three principal links through co-investment with joint investments in a bilateral portfolio:

1. DCLAS FP1 priority setting and enabling environments, where the options by context approach co-developed by FTA and Dryland Systems in phase 1 is being taken forward with a link to the systems analysis, synthesis and scaling CoA in the FTA FP3 livelihood systems. (Co-invested bilateral projects: DryDev and BioDev)

2. DCLAS FP5 sustainable land and water management, where tree options for land restoration and intensification are co-developed with the ‘trees in support of sustainable intensification’ CoA in FTA FP3 livelihood systems (Co-invested bilateral projects: IFAD/EU Dryland Restoration, including ICRAF, ICARDA, ILRI and ICRISAT)

3. DCLAS FP6 improved rural livelihood systems, where modelling impacts of options on livelihood outcomes and implications for scaling across landscapes are jointly developed with the systems analysis, synthesis and scaling CoA in the FTA FP3 livelihood systems. (Co-invested bilateral projects: AfricaRising, Trees4FoodSecurity).
4. IWMI

The CRP DCLAS aims to “transform agricultural value chains in the mixed dryland systems of Africa and Asia from underperforming to functioning through research that breeds reliable and marketable commodities, that provides risk-management practices and tools for all sectors of the value chain and that brokers relationships where mutual benefits can lead to investment in value chain services.”

Ensuring fresh water availability in time and space will continue to be a critical factor for resilient crop-livestock systems developments in drylands. This involves the IWMI-mandated R4D area of managing access to and impacts on water resources, on-farm and beyond, to address risk management practices and tools that contribute to the DCLAS systems research components on “sustainable intensification and establishing resilience”.

IWMI’s contribution to DCLAS, distinct from CRP docking stations and other linkages between DCLAS and WLE II, as a partner (Tier 2), builds on joint efforts in CRP Drylands Systems, and collaborations in specific locations with DCLAS partners including ICARDA, ILRI, ICRISAT and ICRAF. In particular, the issue of impact on water resources under processes of sustainable intensification, is relevant to IWMI expertise and our established networks. Below we propose some specific areas of collaboration based on ongoing and potential future joint interests.

<table>
<thead>
<tr>
<th>DCLAS Flagship</th>
<th>Relevant activity clusters</th>
<th>IWMI’s potential contribution</th>
<th>Comment</th>
<th>Contact Person (DCLAS/IWMI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Climate variability and change impact analysis and strategies for adaptation</td>
<td>Impact assessment to achieve sustainable intensification beyond the farm system</td>
<td>IWMI – GP/RI/SW/WF strategic effort to scope trends and drivers relevant to water, and AWM</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Socio-demographic drivers of change at scale</td>
<td>Possibly assist with trade-off analysis for landscape scale impact of diversification of livelihoods options</td>
<td></td>
</tr>
</tbody>
</table>

[^13]: In DCLAS document: links to PIM, WLSE, and potentially other AFS CRPs
| FP5: Integrated Land & Water Productivity\(^{14}\) | Water and land allocation and conservation  
Sustainable land management, restoration and carbon sequestration  
Integrated soil-crop-water-nutrient management  
Cropping pattern and sequence  
Mechanization of farm operations | Enhancing the role of agricultural water management incl. soil moisture and irrigation in DCLAS value chains alongside agronomy and mechanization change  
Developing the means for sustainable intensification of DCLAS mandate crops/crop –livestock systems in dryland environments subject to long-term reduction of water resources, including analysis of GW use and mgt  
Understanding of water flows management through modelling and existing monitoring for access and support of DCLAS crops and value chains in dryland agro-ecological systems  
The development of cropping strategies for salinity affected areas using licorice | IWMISW/RI already do piloting and HH-Community level assessments of AWM (for soil moisture management and irrigation) in dryland areas with arrange of mostly participatory approaches with farmers, which are subject for outscaling  
IWMISW has tested innovations in mechanization  
IWMI-RI works with sustainable intensification of irrigation strategies and schemes incl. ITC-managed models  
Note: For CRP to CRP coordination the synergies and areas of potential overlap will be addressed in the docking station development, | Theib Oweis / Jennie Barron & Ina Makin |

\(^{14}\) In the DCLAS document the following is mentioned: An important linkage is needed with WLSE CRP. Interactions between field and farm levels of FS4 with landscape/watershed levels in WLSE are important. Upstream downstream consequences of interventions are another linkage. In-situ vs. macro level modeling is another linkage.
<table>
<thead>
<tr>
<th>FP6: Livelihoods and systems</th>
<th>Not clear which activity clusters</th>
<th>Research on:</th>
<th>IWMI-GP/SW/RI hosts various efforts on HH livelihood assessments and social-institutional work related to drylands water management and impact assessments for poverty, gender and environmental issues</th>
<th>Peter Thorne/ Alan Nicol &amp; Everisto Mapedza</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>- Water-smart agricultural and livelihood systems: ways of improving the systematic practical support provided to farmer (and agro pastoralist) decision making on technologies and practices that enhance water use efficiency, effectiveness and food and nutrition security outcomes in a range of drylands areas. This includes using information technologies and new ways as part of farmer outreach and supporting improved peer-to-peer learning approaches.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Cross cutting: Gender

- Contribute towards strategic gender research which builds on the cross CRP Drylands Global Norms and Agency study
- Bring findings from the ongoing gender and agricultural extension research to inform sustainable intensification options
- Mainstreaming gender in the technological and institutional solutions proposed under the CRP and assess their relevance and usefulness for men, women and young people
- Access and control of benefits from increased productivity for men and women.
- Establish research on youth and gender interrelationships in farm/pastoralist level community decision making on food security systems

### Livestock

<table>
<thead>
<tr>
<th>Sub-IDOs</th>
<th>Flagship links – focus of interaction</th>
<th>Livestock flagship</th>
</tr>
</thead>
<tbody>
<tr>
<td>Closed yield gaps through improved agronomic and animal husbandry practices</td>
<td>Pre-Breeding &amp; Trait Discovery - Co-investment in trait discovery for full purpose (food, feed and fodder) cereals and legumes&lt;br&gt; Variety Development - Co-investment in breeding full purpose (food, feed and fodder) cereals and legumes. &lt;br&gt;Seed Systems and Input Services - The potential to collaborate on forage seed delivery systems in drier areas will be explored</td>
<td>Feed, fodder and forage</td>
</tr>
</tbody>
</table>

IWMI-GP

Everisto Mapedza & Alan Nicol
### Agricultural systems diversified and intensified in ways that protect soils and water.

- Integrated Land Water and Crop Management - Co-location and co-investment of research on environmental impacts and mitigation at the farm scale. Research in CRP Livestock will underpin livestock-related impacts in support of research in the DCLAS sites

### Closed yield gaps through improved agronomic and animal husbandry practices.

- Improved Rural Livelihood Systems - Colocation and co-investment in research on the contribution of livestock to livelihood systems in the DCLAS research sites.

### Reduced pre- and post harvest losses, including those caused by climate change.

- Post-harvest Value and Output Markets - Research on post-harvest (storage and processing) under DCLAS will include livestock products (e.g. meat milk) and will build on information and innovations developed in the CRP Livestock

### Collaboration with DCLAS, Wheat, Maize, Rice, RTB Enhanced genetic gains

- A cross-CRP platform linking the Livestock CRP with several of the other agri-food systems CRPs will be established aimed at improving fodder resources from crop residues. This work will be embedded in the trait discovery and CRP breeding flagships of Rice, Maize, RTB and DCLAS) using the “full purpose crop” concept that concomitantly, improves food, feed and fodder traits of crops with no additional land and water need, but guided by the Livestock CRP

### Closed yield gaps through improved agronomic and animal husbandry practices

#### 6. PIM

<table>
<thead>
<tr>
<th>DCLAS Cluster</th>
<th>Related Activity of Collaborating or Complementary CRP</th>
<th>Is the activity Joint or Complementary?</th>
<th>Site of Action</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FP1: Priority Setting &amp; Impact Acceleration 1.1. Foresight, priority setting &amp; learning</strong></td>
<td>PIM cluster 1.1 on Foresight Modelling which provides inputs to priority setting for the system, for CRPs and centers</td>
<td>Joint</td>
<td>Global</td>
</tr>
<tr>
<td><strong>FP1: Priority Setting &amp; Impact Acceleration 1.2. Value chains, demands &amp; constraints</strong></td>
<td>PIM cluster 3.1 on Enabling Value Chains, which quantifies the major distortions and inefficiencies in value chains and prioritizes those for research</td>
<td>Joint</td>
<td>Global with focus on CGIAR countries of collaboration</td>
</tr>
<tr>
<td><strong>FP1: Priority Setting &amp; Impact Acceleration 1.3. Climate change (CC) impact analyses</strong></td>
<td>PIM cluster 1.1 on Foresight Modelling which provides inputs to priority setting for the system, for CRPs and centers</td>
<td>Joint</td>
<td>Global</td>
</tr>
</tbody>
</table>
| **FP1: Priority Setting & Impact Acceleration** | **FP2**: Priority Setting & Impact Acceleration  
1.4. Empowering women and youth though inclusive innovation and learning | PIM Flagship 6 on Gender and Agricultural Development (PIM to provide priority areas for empowerment, analyses of options and methods for other CRP to use) and Cluster 2.1 on Job Creation and Inclusive Growth (PIM to provide analyses of trends, constraints and opportunities for the youth x gender in selected countries) and policy options | Complementary | Focus on CGIAR countries of collaboration |
| **FP1: Priority Setting & Impact Acceleration** | **FP1**: Priority Setting & Impact Acceleration  
1.5. Drivers of adoption & enabling environment | PIM Cluster 1.3 on Enabling Adoption of Technology - learning network established to undertake some collaborative research and joint synthesis on drivers of adoption in selected countries | Joint | Focus on CGIAR countries of collaboration |
| **FP1: Priority Setting & Impact Acceleration** | **FP1**: Priority Setting & Impact Acceleration  
1.6. Monitoring, impact assessment & scaling | PIM Cluster 1.3 on Enabling Adoption of Technology - learning network established to share methods for impact assessment | Complementary | Global |
| **FP4: Seed Systems & Input Services 4.1. Research on seed systems & other agro-inputs** | **FP4**: Seed Systems & Input Services 4.1. Research on seed systems & other agro-inputs | PIM cluster 1.2 on Policies for Agricultural Science, Technology and Innovation will conduct research on cross-cutting constraints and policy options for seed systems | Complementary | Global with focus on CGIAR countries of collaboration |
| **FP4: Seed Systems & Input Services 4.4. Access to production inputs** | **FP4**: Seed Systems & Input Services 4.4. Access to production inputs | PIM Cluster 3.2 on Strengthening Value Chains will include some research on understanding common constraints on access to inputs and undertaking research on innovations to overcome the constraints | Joint and complementary | Global with focus on CGIAR countries of collaboration |
5.5. Mechanization of farm operations | Cluster 2.1 on Job Creation and Inclusive Growth includes research on policies to facilitate the diffusion of mechanization in Africa | Complementary | Selected countries of Africa |
| **FP6: Improved Rural Livelihood Systems** | **FP6**: Improved Rural Livelihood Systems  
6.1. System-specific ex-ante analyses and prioritization | Cluster 1.1 on Foresight Modelling, activity on understanding trade-offs in agricultural intensification -- models and tools developed for use by other CRPs and centres | Complementary | Global |
| **FP6: Improved Rural Livelihood Systems**  
6.4. Enabling environments for widespread adoption | Much of PIMs research will contribute to an enabling environment for widespread adoption; PIM Cluster 1.3 on Enabling Adoption of Technology will test different dissemination approaches and tools for widespread diffusion of technology | Joint and complementary | Focus on CGIAR countries of collaboration |
| --- | --- | --- | --- |
| **FP6: Improved Rural Livelihood Systems**  
6.5. Wider institutional environments | All of PIMs research will contribute to improved enabling policy and institutional environment | Complementary | Global with focus on CGIAR countries of collaboration |
| **FP7: Post-harvest Value & Output Markets**  
7.1. Improved technology and knowledge for small-scale processors | PIM Cluster 3.2 on Strengthening Value Chains will include an emphasis on quantifying post-harvest losses and developing a research agenda around innovations to reduce the losses | Joint | Focus on CGIAR countries of collaboration |
| **FP7: Post-harvest Value & Output Markets**  
7.2. Improved Post-harvest handling and storage | PIM Cluster 3.2 on Strengthening Value Chains will include an emphasis on quantifying post-harvest losses and developing a research agenda around innovations to reduce the losses | Joint and complementary | Focus on CGIAR countries of collaboration |
| **FP7: Post-harvest Value & Output Markets**  
7.3. Diversity for food feed and fodder | PIM Cluster 3.2 on Strengthening Value Chains will include collaborative research on value chain inefficiencies that occur across many commodities | Joint | Focus on CGIAR countries of collaboration |
| **FP7: Post-harvest Value & Output Markets**  
7.4. Policies, institutions and development of strategies to link different stakeholders to markets with deliberate focus on women and youth | PIM cluster 3.1 on Enabling Value Chains, which will analyze policy options to reduce market inefficiencies and provide an enabling environment for investment in value chains | Complementary | Focus on CGIAR countries of collaboration |
| **FP7: Post-harvest Value & Output Markets**  
7.6. Linking with medium and large private enterprises | PIM Cluster 3.3 on Upgrading of Value Chains at Scale -- tests and identifies models for scaling up value chain innovations, including those related to post harvest losses | Joint and complementary | Focus on CGIAR countries of collaboration |
Annex 8. GOVERNANCE & MANAGEMENT OF DCLAS

A SINGLE BALANCED GOVERNING BODY FOR

THE CGIAR RESEARCH PROGRAM ON Dryland Cereals and Legumes Agrifood Systems

DRYLAND CEREALS AND LEGUMES AGRI-FOOD SYSTEMS STEERING & ADVISORY COMMITTEE

Preamble
The proposed governance structure of the new CGIAR Research Program on Dryland Cereals and Legumes Agrifood Systems (DCLAS) will take into consideration recommendations from the IEA, CRP Audit and lessons learned from each of the three CRPs (Dryland Cereals, Dryland Systems, and Grain Legumes) merged into an integrated program. Recommendations from the Review of CRP Governance and Management (April 2014) by the Independent Evaluation Arrangement (IEA) of the ISPC supports the creation of a single balanced governing body for improved effectiveness and efficiency. Though the recommendations of the IEA remain yet to be approved by the Consortium Board and Fund Council, DCLAS is preparing for a smooth transition during 2016 towards a combined Steering and Advisory Committee (SAC) without losing the independence of an unbiased advisory component to support the success of the new CRP.

Current SAC Membership:

Dryland Cereals (as on July 2015):
- David Bergvinson, Director General, ICRISAT, India (Chair)
- Mahmoud Solh, Director General, ICARDA
- S. Ayyappan, Director General, ICAR, India (Represented by Swapan Datta, Deputy Director General for Crop Science, ICAR)
- Abdolallii Ghaffari, Director General, DARI, Iran
- Bernard Hubert, President, CRAI and Agropolis, France
- Yilma Kebede, Senior Program Officer, BMGF
- Peter Langridge, Australian Center for Plant Functional Genomics, Australia (Chair)
- Eric Danquah, Director, WACCI, Ghana
- Greg Edmeades, Independent Consultant, New Zealand
- RS Mahala, Research Director, Millet & Cotton Product Improvement, Pioneer Overseas Corporation, India
- Ivan Rwomushana, Program Manager, Staple Crops Program, ASARECA, Uganda
- Margaret Smith, Professor of Plant Breeding and Genetics, Cornell University, USA

Grain Legumes (as on July 2015)
- Abdulkadir Aydogan, General Directorate of Agricultural Research (GDAR), Turkey
- Asnake Fikre, Director of Crop Research Process, Ethiopian Institute of Agricultural Research, Ethiopia
- Jeet Singh Sandhu, Deputy Director General, Crop Science, ICAR, India
- Ruben Echeverria, Director General, CIAT
- Jeffrey Ehlers, Program Officer, BMGF, USA
- Flavio Breseghello, Head, Rice and Beans, EMBRAPA, Brazil
- Nteranya Sanginga, Director General, IITA, Nigeria
- Mahmoud Solh, Director General, ICARDA, Morocco
- David Bergvinson, Director General, ICRISAT, India

Dryland Systems (as on July 2015)
- Harry Palmier, GFAR, ISC Chair
Recommendation 1 of the IEA Review on CRP Governance & Management, April 2014

Create a single, balanced governing body for each CRP that reports directly to the lead center board on the performance of the program. The CRP governance body should bring together appropriate expertise, include a majority of independent expert members, and accommodate lead center and partner representation.

The recommendation creates a more effective and efficient structure for providing immediate accountability and support for priority setting, resource allocation and evaluation of the CRPs. A CRP leader would be directly accountable to this body for performance. A single, balanced, expert and independent body assures donors, partners and stakeholders that no interests but the best interests of the program will shape deliberations. It assures lead center boards of an independent mechanism for assuring program performance and maintains their accountability function in the current program agreements. The recommendation eliminates duplicative structures and contributes to more efficient decision-making.

Responsibility for action: Consortium Board

Timing: 2015 renewal of program plans

PROPOSAL

It is proposed that the SAC is formed by the merger of balanced representation from the three CRP IAC/SC Committees and to be augmented by increased diversity and stakeholder representation as we consolidate SAC membership to 12 to 14 members. To aid us in this process a Diversity and Skills table that was used by Grain Legumes will be applied that includes areas of expertise and scientific skills, governance and management-related skills, CGIAR experience, Gender, and Nationality. The process to transition to a combined SAC will start in January 2016 for an integrated SAC to begin its responsibilities by January 2017. It is recognized that the proposed structure may require alterations during this period in terms of both membership and responsibilities. Such possibilities will be continually evaluated and changes implemented as required. The committee reports to the Governing Board of ICRISAT, Lead Center for the new CRP on Dryland Agrifood Systems and Legumes.

Responsibilities:
The IEA Governance & Management Review, Table 12 identifies:
The CRP governing body’s responsibilities should include:

- Strategic oversight of the program, including priority setting and the evaluation of results
- Overseeing external evaluations of CRP programs and activities
- Maintaining awareness of stakeholder perspectives and needs
- Serving as the direct report for the CRP leader and conducting an annual performance review (and overseeing the selection process when necessary)
- Reporting at least annually to the lead center’s board through the lead center board chair or the chair of the board’s program committee

Thus the Steering and Advisory Committee (SAC) has overall responsibilities for strategic direction, management oversight, stakeholder participation, risk management, conflict management, audit and evaluation.

The Committee will:

- Provide overall strategic direction for the CGIAR Research Program on Dryland Cereals and Legumes Agrifood Systems
- Ensure program alignment with agreed System Level Outcomes/Sustainable Development Goals
- Provide advice to the ICRISAT Governing Board and the CRP Director on the quality and relevance of the program research portfolio and the allocation of resources
- Make, or approve, decisions on budget allocations between participating Centers and Flagship Projects, for partnerships and for capacity building based on recommendations of the Research and Management Committee with support of the Finance Unit.
- Provide guidance for the CRP Director to ensure the TOR for the Director are followed
- Identify and suggest strategic alliances
- Communicate program resource shortfalls to the ICRISAT Governing Board, for advice or representation to the Consortium Board
- Provide advice on resource mobilization
- Monitor overall progress and execution of the program
- Establish guidance for, and oversee, conflict resolution
- Provide oversight for audit or commissioned evaluations of the program as necessary
- Serve as direct report for the CRP Director on program and strategy while the CRP Director reports to the Lead Center DG regarding administration

The Subcommittee for Independent Advice will consist a subset of the SAC members that have no direct research or financial interests in the CRP and can offer an independent and unbiased perspective on the challenges and opportunities for effective performance of the program. These discussions will be inclusive of, but not limited to, the following:

1. Are research planning and goal setting in the CRP thorough and fit for purpose?
2. Is the overall framework, internal competencies, staffing and budget of the CRP sufficiently robust to address the planned goals of the CRP?
3. Is the CRP Director sufficiently empowered to
   a. Collect and report CRP-relevant information
   b. Ensure quality performance of members of the Research Management Committee
   c. Allocate or redistribute research budgets within CRP projects
4. Development, use and monitoring of the theories of change and impact pathways of the program to enhance the probability of impact
5. Implementation of management for outcomes
6. Development and implementation of best practices for partnership
7. Incorporation of gender research into the program
8. Inclusion of cutting edge science to address the most pressing development challenges
9. Appropriate inclusion of capacity strengthening in the program
10. Evidence of impact
11. Cross-cutting issues as well as boundary issues with other CGIAR Programs

Membership:
The IEA review on Governance and Management suggests the following:

<table>
<thead>
<tr>
<th>The CRP governing body’s composition should include:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- a majority of independent members</td>
</tr>
<tr>
<td>- individuals known and respected for their professional expertise</td>
</tr>
<tr>
<td>- a balance in gender</td>
</tr>
<tr>
<td>- geographic balance with representation from CRP target regions</td>
</tr>
<tr>
<td>- partner and stakeholder representation</td>
</tr>
<tr>
<td>- <em>ex officio</em> representation of the lead center DG and CRP leader</td>
</tr>
</tbody>
</table>

The size of the governing body should be functional, enabling participation and making management and support of the body reasonable for CRP management.

<table>
<thead>
<tr>
<th>The CRP governing body’s members appointment should be as follows:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Members should be appointed by the lead center board for a fixed term, with a single option for renewal at the recommendation of the governing body</td>
</tr>
<tr>
<td>- the chair should be an independent member elected by members of the governing body for a fixed term</td>
</tr>
<tr>
<td>- The basis for including partners or stakeholder representatives should be clearly articulated with the expectation that representative members will participate in their individual capacity and minimize both conflicts of interest and the appearance of conflicts of interest</td>
</tr>
</tbody>
</table>

It is proposed to merge the current Steering Committee and the Independent Advisory Committee for the three CRPs to become one Steering and Advisory Committee. This merged membership is proposed to be augmented by additional partner/stakeholder representation, as well as by representation of diversity in gender and expertise. A list of potential new members will be prepared by the CRP Director with advice from the current Steering Committee and the Independent Advisory Committee by the end of the year for submission to the Governing Board.

The Lead Center DG and CRP Director will be *ex officio* members of the Steering and Advisory Committee. Chair of the new SAC will be nominated and voted by the new combined SAC membership. The Chair of the SAC will report to the Board Chair of the Lead Center (ICRISAT). The term of the Chair will be two years with the successor.

Meetings:
The Steering and Advisory Committee will meet twice in a year, one of which can be by video/audio-conference. Each meeting will include, but is not restricted to, reports from the CRP Director, discussion of the report, and discussion of forthcoming activities and issues. Time will be allocated during these meetings for a separate meeting of the Subcommittee for Independent Advice. The committee will be considered quorate if at least 50% of the membership is present.

Reporting and Reports:
The Steering and Advisory Committee will report to the Governing Board of ICRISAT (Lead Center for Dryland Cereals and Legumes Agrifood Systems). The Committee will provide a report at least once a year to the ICRISAT Governing Board. The Subcommittee for Independent Advice will provide its report to the ICRISAT Governing Board, the Steering and Advisory Committee of Dryland Cereals and Legumes Agrifood Systems, and the Research Management Committee of Dryland Cereals and Legumes Agrifood Systems, through the respective Chairs. The CRP Director will serve as secretary for the Steering and Advisory Committee, and can serve as secretary for the Subcommittee for Independent Advice where necessary.
DRAFT Guidelines for Selection and Terms of Reference for  
Leaders of Flagships and Clusters of Activities

FLAGSHIP LEADERS

Profile:
Flagship Leaders will:

- Have good knowledge about the CGIAR Research Program on Dryland Cereals and Legumes AgriFood Systems (DCLAS), and its partners
- Be committed to the success of the CRP DCLAS in delivering against its agreed outputs and outcomes
- Be internationally recognized in research for development (R4D) on one or more of the target crop or on dryland production systems
- Appreciate the importance of cohesive implementation across the entire delivery pipeline of the CRP for impact at scale
- Lead implementation of the Flagship R4D across all target production systems within the context of the full delivery pipeline of the CRP
- Be result-oriented with demonstrated leadership, mentoring and communication skills
- Be currently active in R4D on one or more of the crops, regions and production systems addressed by CRP DCLAS
- Be nominated by the relevant CG centers, recommended by the Research Management Committee to the Steering and Advisory Committee of the CRP for approval. Appointments will be made by the Lead Center Director General.

Responsibilities:

- Contribute to the success of the CRP by providing technical and administrative support for her/his Flagship
- Support the CRP Director in conducting collegial and constructive dialogues during meetings
- Participate in one main Research Management Committee (RMC) meeting, which will be back-to-back together with (a) an Annual Research Forum, and (b) a meeting of the Steering and Advisory Committee. *Any additional meetings for specific discussion topics will be through audio/video conferencing.*
- Discuss and finalize CRP plans and activities during the main annual RMC meeting with specific relevance to her/his Flagship
- Conduct Annual Project Reviews for her/his Flagship during the main annual RMC meeting
- Make recommendations on budget distribution across CoAs in her/his Flagship based on discussions at the main annual RMC meeting
- Make decisions on activities to be conducted and/or terminated within her/his Flagship depending on performance. Flagship leaders will thus assist in monitoring and evaluating the CRP, including:
  - Review of projects/activities, work plans and performance indicators
  - Monitoring scientific quality and productivity of projects/activities and recommending adjustments
  - Identifying and advising the CRP management on strategic areas for future research
- Work closely with the Leaders of Clusters of Activities to coordinate activities across themes or regions
- Ensure synchronization of work planning between the CRP and the respective partners including centers, regions or countries
- Ensure that projects/activities relevant to approved CRP outputs and outcomes are mapped to the CRP, and that budget is aligned to approved activities
- Ensure timely budget distribution to activities in relevant partner centers and organizations
- Ensure timely delivery of high-quality work plans and activity reports from relevant partner centers/regions/countries to the CRP office
• Monitor progress of projects within Flagships, crops, regions and countries as relevant and help eliminate roadblocks
• Help ensure scientific rigor, quality and momentum in R4D activities in the Flagship
• Identify staffing needs to deliver on agreed Flagship Performance Indices, and propose staffing solutions to the RMC for recommendation to the Steering & Advisory Committee.
• Enable resource mobilization through the identification and coordinated utilization of bilateral funding opportunities
• Represent the CRP, when required, in external meetings and fora
• Serve, as required, on sub-committees relating to (1) review of grants, (2) scholarship administration, and (3) partnership strategies

CoA LEADERS

Profile:
CoA Leaders will:
• Be recognized subject-matter experts in the R4D area relevant to their CoA
• Willing and knowledgeable to be able to work across the target crops, target countries and production systems, rising above possible habit- and background-driven focus on one crop, country or production system
• Be nominated by the relevant CG centers, recommended by the Research Management Committee to the Steering and Advisory Committee of the CRP for approval. Appointments will be made by the Lead Center Director General.

Responsibilities:
• Serve as the frontline figure for her/his CoA
• Work closely with scientist across CG centers and partner institutions to ensure coordinated outcomes
• Coordinate scientists’ activities with relevance to her/his respective CoA across CRP countries, regions and partners
• Liaise closely with appropriate Research Programs and Research Program Directors in the participating CG Centers
• Assist the RMC in preparing project activities tailored to the outputs and outcomes of the CoA
• Coordinate timely, effective and efficient work planning and reporting within each CoA, across crops and regions as necessary
• Identify cross-cutting research across crops and regions within each CoA, and coordinate for efficient implementation
• Identify and establish new partnerships for efficient and expedient delivery of the outputs of the CoA in consultation with the Flagship Leader
• Highlight progress and promote the visibility of success through active engagement with the CRP Communications Manager

Reporting Line and Engagement:
CoA Leaders will report all CRP-related and CRP-funded activities to relevant Flagship Leaders, who in turn will report the compiled Flagship information to the CRP Director. Flagship Leaders will bi-annually (mid-term, year-end) evaluate performance of CoA leaders with respect to their performance on CRP-related activities, and the CRP Director will bi-annually evaluate performance of Flagship Leasers with respect to their performance on CRP-related activities. Evaluation results and recommendations will be communicated to the home institution and the CRP Steering & Advisory Committee.
Engagement as Flagship Leaders and CoA Leaders will be with the agreement of the home institution and they will continue to be affiliated with the home institution for other R4D activities. Renewal of engagement is on a yearly basis, subject to continued ability to allocate time, satisfactory performance, recommendation of the Flagship Leader (for CoA Leaders) and of the CRP Director (for FS Leaders) to the CRP Steering & Advisory Committee, and approval by the CRP Steering & Advisory Committee.

*Note:* Both non-CG and CG partners can be Leaders of Flagships and of Clusters of Activities. However, during the first year of the CRP it is proposed to have CG leadership for all flagships and CoAs, and from the second year onwards subsequent years’ leadership from partners will be solicited.
Annex 9. THE DRAFT ORGANIZATIONAL CHART FOR DCLAS

Lead Center Governing Board

through Chair, SAC

Lead Center DG

Steering and Advisory Committee (SAC)

CRP Director

Program Management Unit

Program Manager

Communication Manager

Finance

Administrative Officer

Research Management Committee (RMC)

RMC Core Team
(with DDG-R of participating centers)
Liaison with partners

RMC Technical Team

Leader Flagship 1
Priority Setting & Adoption

Leader Flagship 2
Crop Improvement

Leader Flagship 3
Seed Systems & Input Services

Leader Flagship 4
Land & Water Productivity

Leader Flagship 5
Livelihood Systems

Leader Flagship 6
Post-harvest Value & Output Markets

Gender Scientist
Annex 10. MONITORING, EVALUATION & LEARNING SYSTEM FOR DCLAS

Monitoring, Evaluation and Learning System for Dryland Cereals and Legumes Agri-food Systems CGIAR Research Program

The Dryland Cereals and Legumes Agri-food Systems CGIAR Research Program is a new program dedicated to reduce poverty, increase food and nutritional security, and better manage natural resources and ecosystems services especially for resource poor farmers and with an emphasis on dryland agroecological systems. The leadership team realizes the need for a monitoring, evaluation and learning (MEL) system to collect information from the project, to monitor progress of proposed activities, learn from successes and failures, and also evaluate and understand project progress for both impact assessment and foresight planning. This document briefly discusses the processes and required resources to design and develop M&E system required for the CRPs in line with the M&E strategy that is already in place.

Goal
The main goal is to develop and bring a common MEL system in use by the three phase I CRPs that will contribute substantially to DCLAS. This will be developed and adapted from the current system (http://mel.cgiar.org/user/login) developed by Dryland Systems and under customization for Dryland Cereals and Grain Legumes to monitor the project progress with short intervals and also to assess the project time to time that includes success and failures thereby provide support to evidence- and foresight-based strategic planning, priority setting and data-based assessment of impact.

Design and Development of M&E System: Process and Execution Method
There are four critical components identified in the proposed M&E system

- **A Logical Framework** that specifies the goal, outcomes, and outputs of the program. This logical framework specifies the objectively **verifiable indicators** that are required to measure programme outcomes and outputs, as well as the means of verification for these indicators.

- **The Data** required to measure progress against these indicators and verify whether targets have been met.

- **A Database** in which information is stored and made accessible to project staff and management

- **A Learning Component** that reflects on the lessons emerging from the MEL process and feeds information back to management and program staff in order to make mid-course corrections to program activities.

To support this framework, the proposed MEL system should have two critical databases

- **Program Management Database** (PMD) that maintains project information; budget allocation and utilization of the budgets at different levels (Flagship Project, Cluster of Activities, Activities)

- **Program Information Database** (PID) that captures and maintains identified and required datasets to facilitate report generation and impact assessment process.
Annex 11. RISK MANAGEMENT IN DCLAS

Risk Management in DCLAS

As a new CRP DCLAS of a larger scale than the three phase I CRPs that are its primary progenitors the management of the proposal envisages some risk from the scale of ambition and complexity of the program. A major risk is that the CRP simply continues prior work rather than rethinking its strategy and seizing the opportunity to redirect work complete some tasks and initiate new ones. A major step towards avoiding this risk is to establish a common MEL platform for the extension phase CRPs which will be replaced. This will be coupled to a more robust management structure that will assess and evaluate proposals for work to be included in the POWB and review their performance as an evaluation of the effectiveness for delivery. This is an internal risk and manageable.

A second major risk concerns funding instability and scale. The project can adjust its ambition with respect to scale, but the variability of W1W2 funding experienced in phase I would seriously threaten the ability of the CRP to undertake its proposed work and to attempt to regain the confidence of its collaborators. This is an external threat and potentially very damaging. Mitigation of this risk is entirely dependent on establishing parallel and synergistic funding streams.

An equally critical aspect is the important role of national and regional policies in the achievement of targets of the Intermediate Development Outcomes of the program. In almost all cases, such policy decisions are beyond the immediate sphere of influence of the program. Persistent and concerted effort, in partnership with key local, regional, national and international influencers, presents the best avenue towards success in these cases.

Supported from W1+W2 funding and this has declined to 26.5% in 2015. W2 funding has remained constant and supportive of the program, but W1 funding has declined considerably. In the extension phase it was ca. 25% of what was anticipated in the proposal document for the CRPs Grain Legumes and Dryland Cereals. The CRP Dryland Systems suffered a major loss of W1W2 funding.

The social and political volatility in some of our target countries interferes with the planned trajectory of the R4D pipeline in these countries. This either creates delays in execution or curtails research for a prolonged period of time. Recent examples include Syria, Mali and Mozambique. Continuation of the research in areas with similar agro-ecologies within other target countries of the program, or in a new target country, until the resolution of existing strife can prevent delays in execution. Once conditions are conducive again, results can be transferred back to the original target country with minimal setbacks.

In addition to these CRP-wide risks there are many risks at lower levels of organisation. Consequently each CoA will compile a risk register that will be reviewed annually with respect to the level of risk and the capacity to implement the management, mitigation or coping strategy. The risk register will be reported upon annually to the lead centre governing board.
### Annex 12. DCLAS BUDGET ESTIMATION

#### Budget Proposed for DCLAS

<table>
<thead>
<tr>
<th>Flagship and Crosscutting Services</th>
<th>Comments (on initial budget assembly)</th>
<th>Final budget for DCLAS (Annual) $ MM</th>
<th>Final budget for DCLAS (2017-2022) $ MM</th>
<th>% of Flagship Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>FP1 - Priority Setting and Impact Acceleration</td>
<td>From DC (FP1) + 0.45 GL (Knowledge, Impact, Priorities and Gender) + DS (0.5 IDO Gender Empowerment) = 3.176 + 3.374 + 4.206 = 14.756</td>
<td>10.756</td>
<td>64.536</td>
<td>9.808</td>
</tr>
<tr>
<td>FP2 - Pre-Breeding, Trait Discovery &amp; Development</td>
<td>From DC (FP2) + GL (FP2 &amp; part FP1) = 8.929 + 6.907 + 6.622 = 22.458</td>
<td>22.458</td>
<td>134.748</td>
<td>20.479</td>
</tr>
<tr>
<td>FP3 - Variety and Hybrid Development</td>
<td>From GL (FP3) + DS (0.5 IDO Food Access) = 14.421 + 3.898 = 18.319</td>
<td>18.319</td>
<td>109.914</td>
<td>16.704</td>
</tr>
<tr>
<td>FP4 - Seed Systems and Input Services</td>
<td>From DC (FP4) + DS (0.5 IDO Food Access) + GL (0.75 FP4) = 3.057 + 3.898 + 5.933 = 12.888</td>
<td>12.888</td>
<td>77.328</td>
<td>11.752</td>
</tr>
<tr>
<td>FP5 - Integrated Land-Water-Crop Management</td>
<td>From DC (FP4) + From DS (0.75 IDO Natural Resource Management) + GL FP1 in part = 3.838 + 16.459 + 4.730 = 25.027</td>
<td>25.027</td>
<td>150.162</td>
<td>22.821</td>
</tr>
<tr>
<td>FP6 - Improved Rural Livelihoods</td>
<td>From DS (IDOs Resilience, and Wealth and Wellbeing) = 5.319 + 7.315 = 12.634</td>
<td>12.634</td>
<td>75.804</td>
<td>11.520</td>
</tr>
<tr>
<td>FP7 - Post-harvest Value &amp; Output Markets</td>
<td>From DS (FP5) + GL (0.25 FP4) + DS (0.5 IDO Capacity to Innovate) = 2.494 + 2.25 + 2.865 = 7.584</td>
<td>7.584</td>
<td>45.504</td>
<td>6.916</td>
</tr>
<tr>
<td><strong>Flagship TOTAL</strong></td>
<td><strong>109.666</strong></td>
<td><strong>657.996</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Governance &amp; Director's Office</td>
<td>From 0.75 DC + 0.75 GL + 0.75 DS = 1.158 + 1.459 + 1.238 = 3.855</td>
<td>3.855</td>
<td>23.130</td>
<td></td>
</tr>
<tr>
<td>Regional Coordination</td>
<td>From DS 1.375 = 1.375</td>
<td>1.375</td>
<td>8.250</td>
<td></td>
</tr>
<tr>
<td>Gender Strategy</td>
<td>From 0.5 DS IDO Gender Empowerment = 4.206</td>
<td>4.206</td>
<td>25.236</td>
<td></td>
</tr>
<tr>
<td>Capacity Development - Knowledge</td>
<td>From DC (Scholarships) + DS (0.5 IDO Capacity to Innovate) + 0.5 GL (Capacity Building &amp; Partnerships) + 0.55 GL (Knowledge, Impact, Priorities and Gender) = 0.250 + 2.865 + 3.421 + 4.00 = 10.536</td>
<td>10.536</td>
<td>63.216</td>
<td></td>
</tr>
<tr>
<td>Capacity Development - Annual Global Research Meeting</td>
<td>From GL Capacity Building and Partnerships</td>
<td>0.500</td>
<td>3.000</td>
<td></td>
</tr>
<tr>
<td>Capacity Development - Infrastructure</td>
<td>From GL Capacity Building and Partnerships</td>
<td>2.000</td>
<td>12.000</td>
<td></td>
</tr>
<tr>
<td>Competitive/Commissioned Grants</td>
<td>From DC and GL (Grants) = 0.65 + 2.393 = 3.043</td>
<td>3.043</td>
<td>18.258</td>
<td></td>
</tr>
<tr>
<td>M&amp;E, and RBM incentives</td>
<td>From GL Capacity Building and Partnerships = 1.420</td>
<td>1.420</td>
<td>8.520</td>
<td></td>
</tr>
<tr>
<td><strong>Administration TOTAL</strong></td>
<td></td>
<td>26.935</td>
<td>161.610</td>
<td></td>
</tr>
<tr>
<td><strong>GRAND TOTAL</strong></td>
<td><strong>136.601</strong></td>
<td><strong>819.606</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Budget from Extension Proposals of DC, DS and GL for 2016

<table>
<thead>
<tr>
<th>Flagship and Crosscutting Services</th>
<th>Dryland Cereals $ (MM)</th>
<th>Grain Legumes $ (MM)</th>
<th>Dryland Systems (Budget by IDO) $ (MM)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flagship 1 Priority Setting &amp; Adoption</td>
<td>3.176</td>
<td>11.352</td>
<td>Resilience</td>
<td>5.319</td>
</tr>
<tr>
<td>Flagship 2 Improved Varieties &amp; Hybrids</td>
<td>8.929</td>
<td>6.178</td>
<td>Wealth and wellbeing</td>
<td>7.315</td>
</tr>
<tr>
<td>Flagship 3 Integrated Crop Management</td>
<td>3.839</td>
<td>14.421</td>
<td>Food access</td>
<td>7.796</td>
</tr>
<tr>
<td>Flagship 4 Seed Systems &amp; Input Services</td>
<td>3.057</td>
<td>8.900</td>
<td>Natural Resource Management</td>
<td>21.945</td>
</tr>
<tr>
<td>Flagship 5 Post-harvest Value &amp; Output Markets</td>
<td>2.494</td>
<td>6.841</td>
<td>Gender Empowerment</td>
<td>8.512</td>
</tr>
<tr>
<td>Flagship 6 Capacity to Innovate</td>
<td></td>
<td></td>
<td></td>
<td>5.730</td>
</tr>
<tr>
<td><strong>Flagship TOTAL</strong></td>
<td><strong>21.495</strong></td>
<td><strong>47.692</strong></td>
<td></td>
<td><strong>56.617</strong></td>
</tr>
</tbody>
</table>

<p>| Governance &amp; Director's Office | 1.544 | 1.945 | 1.650 | 5.139 |
| Regional Coordination |                |                | 1.375 | 1.375 |
| Gender Strategy | 0.350 |                | 1.100 | 1.450 |
| Knowledge, Impact, Priorities &amp; Gender |                | 7.374 |                | 7.374 |
| Grants | 0.650 | 2.393 |                | 3.043 |
| Scholarships | 0.250 |                |                | 0.250 |
| Tools &amp; Platforms for Genotyping &amp; Bioinformatics |                | 0.729 |                | 0.729 |
| <strong>GRAND TOTAL</strong> | <strong>24.289</strong> | <strong>60.133</strong> |                | <strong>59.642</strong> | <strong>145.164</strong> |</p>
<table>
<thead>
<tr>
<th>OT</th>
<th>Sub-IDO</th>
<th>Outputs; Outcomes</th>
<th>Output Targets with Qualifiers ('000s families; '000 ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>E.1.1.1</td>
<td>Prioritization principles established and agreed amongst DCLAS FPs based on analysis of existing gender disaggregated data and planned DCLAS activities for improved efficiency of research investments in Ethiopia</td>
<td>Prioritization principles established and agreed based on analysis of planned DCLAS activities in Ethiopia</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Options testing analysed and lessons incorporated for prioritization principles and continuous implementation in Ethiopia</td>
<td>Continued application of prioritization principles and effectiveness and efficiency demonstrated in Ethiopia</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Continued application of the prioritization (adjusted where required) principles and effectiveness and efficiency demonstrated in Ethiopia</td>
<td>Continued application of the prioritization (adjusted where required) principles and effectiveness and efficiency demonstrated in Ethiopia</td>
</tr>
<tr>
<td></td>
<td></td>
<td>More targeted research across DCLAS in Ethiopia and beyond. Increased efficiency and effectiveness in DCLAS use of human and financial resources in the target areas</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.2.2</td>
<td>Inclusive value chains support mechanisms and scaling options in place</td>
<td>1 value chain assessment in progress</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 value chain assessed for its inclusiveness and growth potential. At least 1 best fit solution identified</td>
<td>1 value chain assessed for their inclusiveness and growth potential. At least 1 best fit solutions scaled through partnerships</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 value chain assessed for its inclusiveness and growth potential. At least 1 best fit solutions scaled through partnerships</td>
<td>At least 2 best fit solutions scaled through partnerships</td>
</tr>
<tr>
<td></td>
<td></td>
<td>At least 5 value chains incl dry land cereals and grain legumes assessed for its inclusiveness and growth potential in Ethiopia and beyond and at least 5 best fit solutions scaled through partners in the target areas</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.1.2</td>
<td>Prioritized options adjusted for climate change and other long term risks in target areas</td>
<td>Future climate and risk profiles outlined for targeted dryland areas in Ethiopia and made available for DCLAS researchers and partner use</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ex-ante assessment mechanisms for FP2, 3 and 5 and priorities established and adapted to the target areas in Ethiopia</td>
<td>1 priority option assessed for its long term suitability across likely future scenarios</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 priority option assessed for its long term suitability across likely future scenarios</td>
<td>2 priority option assessed for its long term suitability across likely future scenarios</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 priority options assessed for its long term suitability across likely future scenarios</td>
<td>At least 5 prioritized options adjusted for climate change and other long term risks in target areas in Ethiopia and beyond</td>
</tr>
<tr>
<td></td>
<td>E.1.3.1</td>
<td>1 priority option adjusted for climate change and other long term risks in target areas</td>
<td>1 priority option adjusted for climate change and other long term risks in target areas</td>
</tr>
<tr>
<td>E.1.4.1</td>
<td>B.1.3</td>
<td>Inclusive innovation system established supporting women and youth empowerment</td>
<td>1 inclusive innovation system for women and 1 for youth functioning and underlying design principles proven (partners trained under outcome CapDev where required). Operating around women farmer groups (3<em>50) and youth groups (3</em>50)</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>E.1.5.1</td>
<td>C.1.1</td>
<td>Diverse farmer typology established , drivers of adoption identified and implications for policy interventions to reach impact at scale assessed</td>
<td>Diversity of farmer present and future demands by context outlined in view of research in DCLAS.</td>
</tr>
</tbody>
</table>
**E.1.6.1** Scaling out options tested and assessed for impact in collaboration with stakeholders

- **D1.2**
  - MLE framework designed and implemented across DCLAS - with specific reference to options by context testing and later assessment
  - Partnership network and mechanisms for engagement in MLE and scaling established and functioning. Option testing supported
  - Options tested across heterogeneous conditions (different contexts) for its potential impact across DCLAS sites
  - 1 scaled option assessed for its early impact across DCLAS regions including spill overs (W Africa)
  - Detailed feedback from impact assessment for DCLAS and stakeholder learning and 2-way strategic adjustments
  - 1 scaled option assessed for its early impact across DCLAS regions including spill overs (W Africa)
  - Dryland communities in target areas in Ethiopia more integrated in the wider economies

**E.1.0.1** Integration of decision makers and end-users along the research process for better grounded interventions

- **D1.4**
  - Most relevant decision makers and end-users (stakeholders) identified trained, and integrated in priority setting and planning process at Ethiopian sites and country level
  - Lessons learned incorporated in wider implementation in target sites in Ethiopia and beyond. Most relevant decision makers and end-users (stakeholders) trained and engaged
  - Early assessment of stakeholder involvement, ownership and mutual learning at target sites and Ethiopia country level
  - Platforms for continuous prioritization and feed-back and learning functional in target sites in Ethiopia
  - Platforms for continuous prioritization and feed-back and learning functional and locally driven in target sites in Ethiopia
  - Integration of decision makers and end-users along the research process for better grounded interventions in target areas in Ethiopia and beyond

**E.1.0.2** Capacities of women, men and youth for the specific needs and methods for the dryland agricultural development agendas enhanced in partner agencies

- **D1.2**
  - Capacity gaps identified and local action plans for inclusive innovation systems agreed for target sites in Ethiopia, including upgrading existing capacities or enabling additional capacities to develop
  - A balanced (male - female, young - old, regional and cultural) set of 10 facilitators trained (training of trainers) in target areas
  - Support for the trained trainers in implementing their work plans in target sites in Ethiopia: training of women and youth groups in innovation systems and facilitate the innovation platforms
  - Assess the lessons learnt from training and implementatio n and fine-tune the training curricula to be available on-line (open access). A balanced (male - female, young - old, regional and cultural) set of 10 facilitators trained in target sites
  - Assessing the process and set up sustainable functional and independent implementation plan for facilitation and spread of training of women and youth facilitators supporting innovation systems and platforms in target sites
  - Monitoring the progress and best practices for facilitation and spread of training of women and youth facilitators supporting innovation systems and platforms in target sites
  - Integration of stakeholders in at least 12 inclusive innovation platforms for long-term ownership and capacity in target sites in Ethiopia and beyond
### FLAGSHIP 2: PRE-BREEDING AND TRAIT DISCOVERY
### FLAGSHIP 3: VARIETY AND HYBRID DEVELOPMENT
### FLAGSHIP 4: SEED SYSTEMS & INPUT SERVICES
#### COUNTRY: ETHIOPIA

<table>
<thead>
<tr>
<th>OT</th>
<th>Sub-IDO</th>
<th>Outputs; Outcomes</th>
<th>Partners</th>
<th>Regions</th>
<th>Output Targets with Qualifies ('000s families; '000 ha)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>FP-FP</td>
<td></td>
<td>2017</td>
<td>2018</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>E.3.6.1</strong></td>
<td>1.1.2, 1.3.3, 1.4.1, 1.4.2,</td>
<td>At least one variety of chickpea released every two years, with (1) at least 10% increased yield over current best variety, OR (2) 10% less yield loss under prevailing drought, low fertility and insect pest OR (3) at least 20% increase in straw yield</td>
<td>EIAR, ACDS, ESE, OSE, ASE, FCUs, Halemaya University, agro-input suppliers, SSTP/AGRA, ARARI, N2 Africa, ISSD</td>
<td>Amhara, Oromiya, Tigray, SNNP; 200,000 ha and 800,000 HH</td>
<td>40,000 ha; 160,000 HH</td>
<td>2 variety released; 20,000 ha; 80,000 HH</td>
</tr>
<tr>
<td><strong>E.3.6.2</strong></td>
<td>1.1.2, 1.4.1</td>
<td>At least one variety of faba bean released every two years, with (1) at least 15% increased yield over current best variety, OR (2) 30% less yield loss under prevailing low soil fertility, waterlogging, foliar and root rot diseases OR (3) at least 20% increase in straw yield</td>
<td>EIAR, Regional Agricultural Research Institutes, ESE, OSE, ASE, FCUs, agro-input suppliers</td>
<td>Amhara, Oromiya, Tigray, SNNP; 450,000 ha and 1.8 million HH</td>
<td>20,000 ha; 80,000 HH</td>
<td>1 varieties released; 20,000 ha; 80,000 HH</td>
</tr>
<tr>
<td><strong>E.3.6.3</strong></td>
<td>1.4.1, 1.3.3, 1.1.2</td>
<td>At least one variety of lentil released every two years, with (1) at least 10% increased yield over current best variety, OR (2) 40% less yield loss under prevailing abiotic and biotic stress, OR (3) at least 15% increase in straw yield and 2% improved nutritional quality (protein yield and micronutrients)</td>
<td>EIAR, Regional Agricultural Research Institutes, ESE, OSE, ASE, FCUs, agro-input suppliers</td>
<td>Amhara, Oromiya, Tigray, 110,000 ha; 440,000 HH</td>
<td>11,000 ha; 44,000 HH</td>
<td>One variety; 16,500 ha; 66,000 HH</td>
</tr>
<tr>
<td>E.3.6.4</td>
<td>1.3.3, 2.1.1</td>
<td>At least one variety of <strong>common bean</strong> released every two years, with (1) at least <strong>10% increased yield</strong> over current best variety, OR (2) <strong>no yield loss</strong> under prevailing abiotic and biotic stress, OR (3) at least <strong>5%</strong> improved whole-grain <strong>nutrition</strong> value (to be defined), OR (4) at least <strong>5%</strong> improved forage/fodder quality/digestibility</td>
<td>EIAR, ACOS, ESE, OSE, ASE, FCUs, Halemaya University, agro-input suppliers, SARI, ORARI, ARARI, N2 Africa, ISSD;</td>
<td>Amhara, Oromiya, Haraghe; 150,000 ha; 250,000 HH</td>
<td>40,000 ha; 80,000 HH</td>
<td>2 varieties; 45,000 ha; 90,000 HH</td>
</tr>
<tr>
<td>E.3.6.5</td>
<td>1.1.2, 1.3.3, 1.4.1</td>
<td>At least one variety of groundnut released every two years, with (1) at least <strong>10%</strong> increased yield over current best variety, OR (2) under prevailing abiotic and biotic stress reducing the yield loss by <strong>20%</strong>, OR (3) at least <strong>2%</strong> improved whole-grain nutrition value (in terms of oil yield and quality and micronutrients), OR (4) at least <strong>10%</strong> improved forage/fodder quality/digestibility</td>
<td>EIAR, Regional Agricultural Research Institutes, ESE, OSE, ASE, FCUs, agro-input suppliers</td>
<td>65,000 m ha; 313,000 HH</td>
<td>200 ha; 962 HH</td>
<td>800 ha; 3800 HH</td>
</tr>
<tr>
<td>E.3.6.6</td>
<td>1.3.3, 2.1.1</td>
<td>At least one variety of <strong>barley</strong> (malt and food) released every two years, with (1) at least <strong>10%</strong> increased yield over current best variety, OR (2) <strong>20% less yield loss</strong> under prevailing drought, foliar diseases and low soil fertility OR (3) at least <strong>15%</strong> improved malt and nutrition quality (to be defined), OR (4) at least <strong>20%</strong> increase in straw yield</td>
<td>FS2, FS3, FS4</td>
<td>Amhara, Oromiya, Tigray; 1,000,000 ha and 4.4 million HH</td>
<td>60,000 ha; 240,000 HH</td>
<td>1 variety released; 70,000 ha; 280,000 HH</td>
</tr>
<tr>
<td>E3.6.7</td>
<td>1.4.1, 1.3.3, 2.1.1</td>
<td>At least one variety of <strong>sorghum</strong> released every two years, with (1) at least 10% increased yield over current best variety, OR (2) 20% less yield loss under prevailing abiotic and <strong>Striga</strong> stress, OR (3) at least 10% improved whole-grain nutrition value (<strong>higher iron concentration</strong>), OR (4) at least 5% improved fodder <strong>quantity</strong></td>
<td>EIAR, ARARI, ORARI, TARI, SARI, BUREAU of Agric. (Amahara, oromiya, SNNPRS, Tigray, ESE, OSE, ASE, ATA, Halemaya University, agro-input suppliers)</td>
<td>95,000 ha; 190,000 HH</td>
<td>95,000 ha; 190,000 HH</td>
<td>194,000 ha; 388,000 HH</td>
</tr>
<tr>
<td>E3.6.8</td>
<td>1.4.1, 1.3.3, 2.1.1</td>
<td>At least one variety of <strong>finger millet</strong> released every two years, with (1) at least 10% increased yield over current best variety, OR (2) no yield loss under prevailing abiotic and biotic stress, OR (3) at least 5% improved whole-grain nutrition value (to be defined), OR (4) at least 5% improved forage/fodder quality/digestibility</td>
<td>EIAR, ARARI, ORARI, TARI, SARI, BUREAU of Agric. (Amahara, oromiya, SNNPRS, Tigray, ESE, OSE, ASE, ATA, Halemaya University, agro-input suppliers)</td>
<td>37,500 ha 75,000 HH</td>
<td>50,000 ha 100,000 HH</td>
<td>75,000 ha 150,000 HH</td>
</tr>
</tbody>
</table>
## FLAGSHIP 5: INTEGRATED LAND, WATER & CROP MANAGEMENT

### COUNTRY: ETHIOPIA

<table>
<thead>
<tr>
<th>OT</th>
<th>Sub-IDO</th>
<th>Outputs; Outcomes</th>
<th>FP links</th>
<th>CG Centers</th>
<th>Partners</th>
<th>Regions</th>
<th>Output Targets with Qualifiers ('000s families; '000 ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>E.5.2.1</td>
<td>3.3.2, 3.1.1, 4.1.2</td>
<td>FP5, FP1</td>
<td>ICRISAT, ICARDA, CIAT, IWMI</td>
<td>Amharra, Oromiya, Tigray</td>
<td>7500 ha of degraded land rehabilitated</td>
<td>21,000 ha of land covered by SW conservation</td>
</tr>
<tr>
<td></td>
<td>E.5.3.1</td>
<td>1.1.2, 1.3.2, 1.3.4, 2.1.2</td>
<td>FP5, FP6</td>
<td>ICRISAT, ICARDA, NARES, NGOs</td>
<td>Amharra, Oromiya, Tigray</td>
<td>20,000 households have access to improved interventions</td>
<td>200,000 households have access to improved interventions</td>
</tr>
<tr>
<td></td>
<td>E.5.4.1</td>
<td>2.1.2, 3.3.2, 3.2.2</td>
<td>FP5, FP6</td>
<td>ICRISAT, CIAT, ILRI, ICARDA</td>
<td>Amharra, Oromiya, Tigray</td>
<td>10% increase in crop yield due to employing integrated conservation technologies over 1st year</td>
<td>About 2 million farmers have access to integrated conservation technologies</td>
</tr>
</tbody>
</table>

**Target Year Breakdown:**
- **2017:**
  - FP5, FP1: Amharra, Oromiya, Tigray
  - E.5.2.1: Sustainable land management/restoration options developed and out scaled
  - E.5.3.1: Integrated management practices for improved crop, water, land & nutrient productivity/efficiency suited to variable and changing climates and farming systems in dryland settings developed and deployed
  - E.5.4.1: Strategies integrating conservation technologies with production solutions to crop and livestock production related constraints validated and implemented
- **2018:**
  - FP5, FP1: Amharra, Oromiya, Tigray
  - E.5.2.1: Sustainable land management/restoration options developed and out scaled
  - E.5.3.1: Integrated management practices for improved crop, water, land & nutrient productivity/efficiency suited to variable and changing climates and farming systems in dryland settings developed and deployed
  - E.5.4.1: Strategies integrating conservation technologies with production solutions to crop and livestock production related constraints validated and implemented
- **2019:**
  - FP5, FP1: Amharra, Oromiya, Tigray
  - E.5.2.1: Sustainable land management/restoration options developed and out scaled
  - E.5.3.1: Integrated management practices for improved crop, water, land & nutrient productivity/efficiency suited to variable and changing climates and farming systems in dryland settings developed and deployed
  - E.5.4.1: Strategies integrating conservation technologies with production solutions to crop and livestock production related constraints validated and implemented
- **2020:**
  - FP5, FP1: Amharra, Oromiya, Tigray
  - E.5.2.1: Sustainable land management/restoration options developed and out scaled
  - E.5.3.1: Integrated management practices for improved crop, water, land & nutrient productivity/efficiency suited to variable and changing climates and farming systems in dryland settings developed and deployed
  - E.5.4.1: Strategies integrating conservation technologies with production solutions to crop and livestock production related constraints validated and implemented
- **2021:**
  - FP5, FP1: Amharra, Oromiya, Tigray
  - E.5.2.1: Sustainable land management/restoration options developed and out scaled
  - E.5.3.1: Integrated management practices for improved crop, water, land & nutrient productivity/efficiency suited to variable and changing climates and farming systems in dryland settings developed and deployed
  - E.5.4.1: Strategies integrating conservation technologies with production solutions to crop and livestock production related constraints validated and implemented
- **2022:**
  - FP5, FP1: Amharra, Oromiya, Tigray
  - E.5.2.1: Sustainable land management/restoration options developed and out scaled
  - E.5.3.1: Integrated management practices for improved crop, water, land & nutrient productivity/efficiency suited to variable and changing climates and farming systems in dryland settings developed and deployed
  - E.5.4.1: Strategies integrating conservation technologies with production solutions to crop and livestock production related constraints validated and implemented

**2022 Outcome:**
- 1 million families benefit due to restoration/halting of 2 million ha degraded land
- 1.5 million farmers will increase their crop yield by 50% through employing integrated conservation technologies
| E5.42 | 2.1.2, 3.3.2, 3.2.2 | Production systems diversified and intensified through suitable expansion of cropping systems, including traditional and non-traditional vegetables and multiple purpose trees, livestock and fish | ICRAID, ILRI, Bioversity | Amhara, Oromiya | Participating households increased access to nutritious food by 10% and income increased by 20% | Participating households increased access to nutritious food by 10% and income increased by 20% over 1st year | Participating households increased access to nutritious food by 10% and income increased by 50% over 2nd year | Participating households increased access to nutritious food by 10% and income increased by 20% over 5th year | Participating households increased access to nutritious food by 10% and income increased by 10% over 4th year | 500000 farm families increased access to nutritious food by 50% and income increased by 100% |
| E5.51 | 3.3.3, 2.4.3, 2.3.1, 2.1.2, 1.3.4 | Appropriate mechanization and agri-informatics for precision agriculture assessed for more efficient use of NRs, labor, inputs and energy by stallholder farmers and implemented at farm scale | ICRAID, ICARDA, CIMMYT | Amhara, Oromiya | 15,000 women and men farmers participating in piloting modern mechanization at their farms. At least two labor saving technical schemes | 15,000 women and men farmers participating in piloting modern mechanization at their farms. At least two labor saving technical schemes | 50,000 women and men farmers participating in piloting modern mechanization at their farms. At least two labor saving technical schemes | 100,000 women and men farmers participating in piloting modern mechanization at their farms. At least two labor saving technical schemes | 200,000 women and men farmers participating in piloting modern mechanization at their farms. At least two labor saving technical schemes | At least 300,000 women and men farmers adapt some form of mechanization at their farms. At least two labor saving technical schemes |
| E5.61 | 2.1.1, 3.3.1, 3.1.2, 2.3.1 | Economically viable integrated Pest (including diseases and parasitic non-parasitic weeds) Management strategies for reducing chemical and antibiotics use and enhance crop and livestock biodiversity in the ecosystem developed and deployed | ICRAID, CIAT | Amhara, Oromiya | 10'000 women and men farmers participating in IPM (+weeds) package with eco-friendly methods and increase of productivity/resilience to CC | 20'000 women and men farmers participating in IPM (+weeds) package with eco-friendly methods and increase of productivity/resilience to CC | 50'000 women and men farmers participating in IPM (+weeds) package with eco-friendly methods and increase of productivity/resilience to CC | 100'000 women and men farmers participating in IPM (+weeds) package with eco-friendly methods and increase of productivity/resilience to CC | 200'000 women and men farmers participating in IPM (+weeds) package with eco-friendly methods and increase of productivity/resilience to CC | 500'000 women and men farmers participating in IPM (+weeds) package with eco-friendly methods and increase of productivity/resilience to CC | 500000 farm families benefit by substituting 50% chemicals by eco-friendly methods and 50% increase of productivity/resilience to CC and reduction of negative impact of chemicals |
### Flagship 6: Improved Rural Livelihood Systems

**Country: Ethiopia**

<table>
<thead>
<tr>
<th>OT</th>
<th>Sub-IDO</th>
<th>Outputs; Outcomes</th>
<th>FP links</th>
<th>CG Centers</th>
<th>Partner</th>
<th>Regions</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
<th>2022 Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>E.6.1.1</td>
<td>Enabling cluster</td>
<td>Farmers offered more effective livelihood options for systems intensification and optimization</td>
<td>FP 6 C6.1 (FP 1 - Jointly developed typologies; contribution to foresight studies). (FP 5 - calibration of landscape scale models)</td>
<td>ILRI, ICRAF, CIAT, ICARISAT, Bioversity, Systems FPs in other CRPs</td>
<td>WUR, CSIRO, NARS</td>
<td>100,000 (10,000 ha)</td>
<td>Appropriate livelihood systems simulation and tradeoff models identified</td>
<td>10 Ex ante impact assessments (disaggregated by system / household type) completed</td>
<td>10 portfolios of options for improving livelihoods established</td>
<td>Continuous refinement of model definition and livelihood portfolios</td>
<td>Livelihood systems / household types analysed across 10 field sites</td>
<td>5000 farmers offered more effective livelihood options for systems intensification and optimization</td>
<td></td>
</tr>
<tr>
<td>E.6.2.1</td>
<td>1.1.2., 1.3.2, 1.3.4., 1.4.2, 2.1.1., 2.1.2., 3.3.3., B.1.1., B.1.2.</td>
<td>Tested, adapted and validated options applied for SI and livelihood diversification applied by farmers</td>
<td>FP 6 C6.2 (FP 1 - align stakeholder platforms with diagnostic studies). (FP 2 - livelihood impacts of loss reduction / value addition, improved germplasm). (FP 4 - testing at landscape scale)</td>
<td>ICRISAT, ILRI, ICRAF, IITA, AVRDRC, Bioversity, Livestock, FTE, Other AFS, CCAFS, A4NH</td>
<td>NARS, Development partners</td>
<td>25 (1000 ha)</td>
<td>10 multi-stakeholder platforms and farmer research groups established</td>
<td>Portfolios evaluated and option combinations selected by 5000 participating core households</td>
<td>Continuous adaptation and refinement of livelihood systems portfolios</td>
<td>Livelihood options tested, adapted and validated across 10 field sites</td>
<td>Tested, validated and adapted options applied for SI and livelihood diversification applied by 25000 farmers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E.6.3.1</td>
<td>3.1.3., 3.2.3., 3.2.3., A.1.1., A.1.4.</td>
<td>Identify strategies (portfolio revision, governance options) for mitigation of negative impacts at scale</td>
<td>FS 6 C6.3 (FP 4 - testing at landscape scale)</td>
<td>ICRISAT, ILRI, ICRAF, CIAT, IITA, Bioversity, WLSE</td>
<td>NARS, Development partners</td>
<td>50 (1000 ha)</td>
<td>Establish monitoring of aggregated impacts of applied livelihood portfolios in 10 sample watersheds / landscapes</td>
<td>Identify positive and negative interactions at landscape scale</td>
<td>Strategies (portfolio revision, governance options) for mitigation of negative impacts at scale identified (across 10 watersheds)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E.6.4.1</td>
<td>C.1.1., D.1.4.</td>
<td>Development partners implement programs with increased adoption rates of improved livelihood strategies</td>
<td>FS 6 C.6.4 (FP1 - MEL of scaling initiatives). (FP7 - prioritisation for value addition)</td>
<td>ICRISAT, ILRI, ICRAF, CIAT, IITA, Bioversity, WLSE, PIM</td>
<td>Review of cases of successful and failed innovation adoption taking the social-ecological system context into account</td>
<td>Development of a systems framework for agricultural innovation adoption</td>
<td>Empirical testing of hypotheses regarding the influence of system features on innovation adoption</td>
<td>Piloting different up- and out-scaling approaches with development partners</td>
<td>Assessing the impact of pilot studies and establishment of co-investment programs for scaling</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------</td>
<td>----------------</td>
<td>-------------------------------------------------</td>
<td>-------------------------------------------------</td>
<td>-------------------------------------------------</td>
<td>-------------------------------------------------</td>
<td>-------------------------------------------------</td>
<td>-------------------------------------------------</td>
<td>-------------------------------------------------</td>
<td>-------------------------------------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E.6.5.1</td>
<td>1.1.2., C.1.2., D.1.1.</td>
<td>Governance mechanisms are revised and harmonized in a way that encourages improved livelihood strategies that are adapted to various dryland contexts</td>
<td>FS 6 6.5D (FP1 - ?). (FP3 - ?). (FP6 - ?)</td>
<td>ICRISAT, ILRI, ICRAF, CIAT, IITA, Bioversity, PIM, WLSE</td>
<td>Analytical tools for analyzing governance challenges and enabling / disabling factors</td>
<td>Governance challenges and enabling / disabling factors relevant to livelihood systems identified</td>
<td>Consultative identification of governance solutions with core stakeholder s</td>
<td>Lobbying and consultation with government and non-governmental agencies</td>
<td>Governance approaches supporting livelihood systems innovation implemented by government and NGOs.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------</td>
<td>----------------</td>
<td>-------------------------------------------------</td>
<td>-------------------------------------------------</td>
<td>-------------------------------------------------</td>
<td>-------------------------------------------------</td>
<td>-------------------------------------------------</td>
<td>-------------------------------------------------</td>
<td>-------------------------------------------------</td>
<td>-------------------------------------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### FLAGSHIP 7: POST-HARVEST VALUE & OUTPUT MARKETS

**COUNTRY: ETHIOPIA**

<table>
<thead>
<tr>
<th>OT</th>
<th>Sub-IDs</th>
<th>Outputs; Outcomes</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
</tr>
</thead>
<tbody>
<tr>
<td>E.7.1.1</td>
<td>1.2.2, 1.3.3, B.1.2, C.1.1</td>
<td>15 technologies identified, refined and transferred to small scale processors</td>
<td>2</td>
<td>4</td>
<td>8</td>
<td>11</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>E.7.1.2</td>
<td>1.2.2, 1.3.3, B.1.2, C.1.1</td>
<td>100 potential entrepreneurs trained on these technology based businesses</td>
<td>10</td>
<td>20</td>
<td>40</td>
<td>60</td>
<td>80</td>
<td>100</td>
</tr>
<tr>
<td>E.7.1.3</td>
<td>1.2.2, 1.3.3, B.1.2, C.1.1</td>
<td>50 entrepreneurs supported for running their business on the mandated crops</td>
<td>5</td>
<td>10</td>
<td>15</td>
<td>25</td>
<td>40</td>
<td>50</td>
</tr>
<tr>
<td>E.7.2.1</td>
<td>1.3.2, 1.3.3, B.1.2, 1.4.1, C.1.1</td>
<td>at least 6 post-harvest and storage technologies identified</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E.7.2.2</td>
<td>1.3.2, 1.3.3, B.1.2, 1.4.1, C.1.1</td>
<td>At least 10 equipment manufacturers engaged for uptake and commercialization</td>
<td>0</td>
<td>3</td>
<td>5</td>
<td>7</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>E.7.2.3</td>
<td>1.3.2, 1.3.3, B.1.2, 1.4.1, C.1.1</td>
<td>Post-harvest losses reduced by 10%</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>5</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>E.7.2.4</td>
<td>1.3.2, 1.3.3, B.1.2, 1.4.1, C.1.1</td>
<td>5000 farmers adopt new technologies to reduce post-harvest</td>
<td>0</td>
<td>0</td>
<td>1500</td>
<td>2500</td>
<td>4000</td>
<td>5000</td>
</tr>
<tr>
<td>E.7.3.1</td>
<td>2.1.1, 2.1.2, 2.1.3, 1.3.1, 1.3.2</td>
<td>At least 5 Food products formulated using locally available crops for addressing mal-nutrition, hidden hunger and lifestyle diseases</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>E.7.3.2</td>
<td>2.1.1, 2.1.2, 2.1.3, 1.3.1, 1.3.2</td>
<td>Increase the usage of traditional crops of feed industry towards adaptation across livestock and allied sectors by 10%</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>7</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>E.7.3.3</td>
<td>2.1.1, 2.1.2, 2.1.3, 1.3.1, 1.3.2</td>
<td>10% adoption of new formulations / products by industry and local population</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>7</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>E.7.4.1</td>
<td>D.1.1, C.1.1, 1.3.2, 1.3.3</td>
<td>At least two marketing strategies for respective value chain actors developed and adopted</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>E.7.4.2</td>
<td>D.1.1, C.1.1, 1.3.2, 1.3.3</td>
<td>At least 10 value chain actors adopting any of the mandate crops / crop based technologies</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>5</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>E.7.4.3</td>
<td>D.1.1, C.1.1, 1.3.2, 1.3.3</td>
<td>Income of farmers and small scale processors increased by 20%</td>
<td>0</td>
<td>5</td>
<td>10</td>
<td>12</td>
<td>15</td>
<td>20</td>
</tr>
<tr>
<td>E.7.4.4</td>
<td>D.1.1, C.1.1, 1.3.2, 1.3.3</td>
<td>Quantity of products sold for value chain actors increased by 20%</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>10</td>
<td>15</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>------------------------------------------------------------------------------</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E.7.5.1</td>
<td>Establishment of 2 DCLAS food processing and food safety business incubation facility</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E.7.5.2</td>
<td>50 start-up entrepreneurs (including women &amp; youth) supported in the area of agri and food business</td>
<td>0</td>
<td>8</td>
<td>15</td>
<td>25</td>
<td>38</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>E.7.5.3</td>
<td>50 entrepreneurs made to grow (increase in sales) by average 20%</td>
<td>0</td>
<td>0</td>
<td>13</td>
<td>25</td>
<td>38</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>E.7.5.4</td>
<td>200 youth &amp; women trained in the area of agribusiness</td>
<td>20</td>
<td>40</td>
<td>80</td>
<td>120</td>
<td>160</td>
<td>200</td>
<td></td>
</tr>
<tr>
<td>E.7.6.1</td>
<td>Public-private partnership facilitated with scientists for technology access</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>E.7.6.2</td>
<td>50 existing medium and large scale industries linked for technologies and market access</td>
<td>5</td>
<td>8</td>
<td>15</td>
<td>30</td>
<td>40</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>E.7.6.3</td>
<td>1000 youth trained on business development skills</td>
<td>100</td>
<td>200</td>
<td>500</td>
<td>700</td>
<td>800</td>
<td>1000</td>
<td></td>
</tr>
<tr>
<td>E.7.6.4</td>
<td>200,000 farmers benefiting by facilitating market access through contract farming and market linkages</td>
<td>0</td>
<td>0</td>
<td>80000</td>
<td>120000</td>
<td>160000</td>
<td>200000</td>
<td></td>
</tr>
</tbody>
</table>
## FLAGSHIP 1: PRIORITY SETTING & IMPACT ACCELERATION

<table>
<thead>
<tr>
<th>OT</th>
<th>Sub-IDO</th>
<th>Outputs; Outcomes</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
<th>2022 Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>IN.1.1.1</td>
<td>through others</td>
<td>Prioritization principles established and agreed amongst DCLAS FPs based on analysis of existing gender disaggregated data and planned DCLAS activities for improved efficiency of research investments in India</td>
<td>Prioritization principles established and agreed based on analysis of existing gender disaggregated data and planned DCLAS activities in Indian target states</td>
<td>Options testing analysed and lessons incorporated for prioritization principles and continuous implementation in Indian target states</td>
<td>Continued application of prioritization principles and effectiveness and efficiency demonstrated in Indian target states</td>
<td>continued application of the periodization (adjusted where required) principles and effectiveness and efficiency demonstrated in Indian target states</td>
<td>continued application of the periodization (adjusted where required) principles and effectiveness and efficiency demonstrated in Indian target states</td>
<td>continued application of the periodization (adjusted where required) principles and effectiveness and efficiency demonstrated in Indian target states</td>
<td>More targeted research across DCLAS in Indian target states and beyond. Increased efficiency and effectiveness in DCLAS use of human and financial resources in the target areas</td>
</tr>
<tr>
<td>IN.1.2.1</td>
<td>1.2.2</td>
<td>Inclusive value chains support mechanisms and scaling options in place in India</td>
<td>Relevant value chain studies synthesised and gaps for inclusiveness assessment gaps identified in collaboration with state universities and ICAR</td>
<td>1 value chain assessed for its inclusiveness and growth potential and best fit solution identified - method shared across state level partners</td>
<td>1 value chain assessed for its inclusiveness and growth potential by state university. At least 1 best fit solutions scaled through partnerships</td>
<td>2 value chains assessed for its inclusiveness and growth potential by state university. At least 2 best fit solutions scaled through partnerships</td>
<td>3 value chains assessed for its inclusiveness and growth potential by state university. At least 2 best fit solutions scaled through partnerships</td>
<td>At least 3 best fit solutions scaled through partnerships</td>
<td>At least 7 value chains assessed for its inclusiveness and growth potential in India and beyond and at least 7 best fit solutions scaled through partners in the target areas</td>
</tr>
<tr>
<td>IN.1.3.1</td>
<td>1.1.2</td>
<td>Prioritized options adjusted for climate change and other long term risks in target areas of India</td>
<td>Future climate and risk profiles outlined for targeted dryland areas in India and made available for DCLAS researchers and private sector breeding partners (e.g. through HPRC) use</td>
<td>Ex-ante assessment mechanisms for FP2, 3 and 5 and priorities established in partnership with national partners</td>
<td>1 priority option assessed for its long term suitability across likely future scenarios</td>
<td>2 priority option assessed for its long term suitability across likely future scenarios</td>
<td>2 priority option assessed for its long term suitability across likely future scenarios</td>
<td>2 priority options assessed for its long term suitability across likely future scenarios</td>
<td>At least 7 prioritized options adjusted for climate change and other long term risks in target areas in India and beyond</td>
</tr>
</tbody>
</table>

COUNTRY: INDIA
<table>
<thead>
<tr>
<th>IN.1.4.1</th>
<th>B.1.3</th>
<th>Inclusive innovation system established supporting women and young people empowerment in target areas of India</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1 inclusive innovation system for women and 1 for young people functioning and underlying design principles proofed (partners trained under outcome CapDev where required). Operating around women farmer groups (3<em>50) and young people groups (3</em>50)</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1 inclusive innovation system for women and 1 for young people functioning and underlying design principles proofed (partners trained under outcome CapDev where required). Operating around women farmer groups (3<em>50) and young people groups (3</em>50)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2 inclusive innovation system for women and 1 for young people functioning and underlying design principles proofed (partners trained under outcome CapDev where required). Operating around women farmer groups (3<em>50) and young people groups (3</em>50)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3 inclusive innovation system for women and 1 for young people functioning and underlying design principles proofed (partners trained under outcome CapDev where required). Operating around women farmer groups (3<em>50) and young people groups (3</em>50)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>4 inclusive innovation system for women and 1 for young people functioning and underlying design principles proofed (partners trained under outcome CapDev where required). Operating around women farmer groups (3<em>50) and young people groups (3</em>50)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>5 inclusive innovation system for women and 1 for young people functioning and underlying design principles proofed (partners trained under outcome CapDev where required). Operating around women farmer groups (3<em>50) and young people groups (3</em>50)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IN.1.5.1</th>
<th>C.1.1</th>
<th>Diverse farmer typology established for the target areas in India, drivers of adoption identified and implications for policy interventions to reach impact at scale assessed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diversity of farmer present and future demands by context outlined in view of research in DCLAS.</td>
<td>Underlying principles established for diversity assessment and matching of technologies across contexts. Strategy for enabling policies shared with DCLAS and stakeholders and fed into established stakeholder fora</td>
<td></td>
</tr>
<tr>
<td>Technologies matched to typologies and contexts. Progress assessment for learning related to adoption and policy implementation</td>
<td>Technologies matched to typologies and contexts. Fine-tuning of typologies and policy messages/communication using available mass communication technologies and other ICT products</td>
<td></td>
</tr>
<tr>
<td>Technologies matched to typologies and contexts. Outcome/effectiveness assessment for learning related to adoption and policy implementation</td>
<td>Improved match of technologies to farmer demands and realities/contexts across target areas in India and the region</td>
<td></td>
</tr>
</tbody>
</table>

At least 12 inclusive innovation systems supporting women and youth empowerment functional and sustainably operating through partners (at least 2 per targeted Indian states).
| **IN.1.6.1** | **1.3.2** | Scaling out options tested in target areas in India and beyond and assessed for impact in collaboration with stakeholders | MLE framework designed and implemented across DCLAS and local implementing partners - with specific reference to options by context testing and later Impact assessment | Partnership network and mechanisms for engagement in MLE and scaling established and functioning. Option testing supported | Options tested across heterogeneous conditions (different contexts) for its potential impact across DCLAS sites | 1 scaled option assessed for its early impact across DCLAS regions including spill overs (across Indian states, to South Asia and potentially to Africa) | Detailed feedback from impact assessment for DCLAS and stakeholder learning and 2-way strategic adjustments | 1 scaled option assessed for its early impact across DCLAS regions including spill overs (across Indian states, to South Asia and potentially to Africa) | Dryland communities in target areas in India more integrated in the wider economies |
| **IN.1.4.1** | **D.1.2** | Capacities of women, men and youth for the specific needs and methods for the dryland agriculture development agendas enhanced in partner agencies in India | Capacity gaps identified and local action plans for inclusive innovation systems agreed, including upgrading existing capacities or enabling additional capacities to develop | A balanced (male - female, young - old, regional and cultural) set of 10 facilitators trained (training of trainers) | Support for the trained trainers in implementing their work plans: training of women and youth groups in innovation systems and facilitate the innovation platforms | Assess the lessons learnt from training and implementation and fine-tune the training curricula to be available on-line (open access). A balanced (male - female, young - old, regional and cultural) set of 10 facilitators trained | Assessing the process and set up sustainable functional and independent implementation plan for facilitation and spread of training of women and youth facilitators supporting innovation systems and platforms. | Monitoring the progress and best practices for facilitation and spread of training of women and youth facilitators supporting innovation systems and platforms. | Integration of stakeholders in at least 12 inclusive innovation platforms for long-term ownership and capacity in target sites in India and beyond |
### FLAGSHIP 2: PRE-BREEDING, TRAIT DISCOVERY & DEVELOPMENT

#### FLAGSHIP 3: VARIETY AND HYBRID DEVELOPMENT;

#### FLAGSHIP 4: SEED SYSTEMS & INPUT SERVICES

**COUNTRY: INDIA**

<table>
<thead>
<tr>
<th>OT</th>
<th>Sub-IDO</th>
<th>Outputs; Outcomes</th>
<th>FP Link</th>
<th>CG Centres</th>
<th>Partners</th>
<th>States</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
</tr>
</thead>
<tbody>
<tr>
<td>IN.3.6.1</td>
<td>1.1.1, 1.1.2, 1.4.1, 2.1.1</td>
<td>At least two variety of <strong>chickpea</strong> released every years, with (1) at least 10% increased yield over current best variety, OR (2) no yield loss under prevailing abiotic and biotic stress <strong>reducing the yield gap by 15%</strong>, OR (3) at least 1% improved whole-grain nutrition value (in terms of protein yield)</td>
<td>FS2, FS3, FS4</td>
<td>ICRISAT, ICARDA</td>
<td>MP, W Bengal, UP, Bihar, Maharashtra; 9.6 m ha, 52.8 m HH</td>
<td>two varieties released 0.96 m ha, 5.5 m HH</td>
<td>two varieties released 1.45 m ha, 8.3 m HH</td>
<td>two varieties released 1.92 m ha, 10.95 m HH</td>
<td>two varieties released 2.45 m ha, 14 M HH</td>
<td>two varieties released 2.92 m ha, 16.65 m HH</td>
<td>two varieties released 3.44 m ha, 19.6 M HH</td>
<td></td>
</tr>
<tr>
<td>IN.3.6.2</td>
<td>1.1.1, 1.1.2, 1.3.3, 1.4.1, 2.1.1</td>
<td>At least one variety of <strong>lentil</strong> released every years, with (1) at least 10% increased yield over current best variety, OR (2) no yield loss under prevailing abiotic and biotic stress <strong>reducing the yield gap by 20%</strong>, OR (3) at least 2% improved whole-grain nutrition value (in terms of protein yield and micronutrients), OR (4) at least 10% improved forage/fodder quality/digestibility</td>
<td>FS2, FS3, FS4</td>
<td>ICARDA</td>
<td>MP, W Bengal, UP, Bihar, Chattisgarh, Jharkand; 1.9 m ha, 10.8 m HH</td>
<td>One variety 0.29 m ha (0.10 m ha new area in rice fallow), 1.6 m HH</td>
<td>One variety 0.40 m ha (0.12 m ha new area in rice fallow), 2.3 m HH</td>
<td>One variety 0.52 m ha (0.14 m ha new area in rice fallow), 3.0 m HH</td>
<td>One variety 0.73 m ha (0.16 m ha new area in rice fallow), 4.2 m HH</td>
<td>One variety 0.85 m ha (0.18 m ha new area in rice fallow), 4.8 m HH</td>
<td>One variety 0.96 m ha (0.20 m ha new area in rice fallow), 5.5 m HH</td>
<td></td>
</tr>
<tr>
<td>IN.3.6.3</td>
<td>1.1.1, 1.1.2, 1.3.3, 1.4.1, 2.1.1</td>
<td>At least one variety of <strong>groundnut</strong> released every two years, with (1) at least 10% increased yield over current best variety, OR (2) under prevailing abiotic and biotic stress reducing the yield loss by 20%, OR (3) at least 2% improved whole-grain nutrition value (in terms of oil yield and quality and micronutrients), OR (4) at least 10% improved forage/fodder quality/digestibility</td>
<td>FS2, FS3, FS4</td>
<td>ICRISAT</td>
<td>Gujarat, AP, Maharashtra, Rajasthan, Karnataka, Tamil Nadu, Odisha; 5.05 m ha, 5.0 m HH</td>
<td>0.001 m ha; 0.001 m HH</td>
<td>0.004 m ha; 0.004 m HH</td>
<td>0.016 m ha; 0.016 m HH</td>
<td>0.064 m ha; 0.064 m HH</td>
<td>0.256 m ha; 0.256 m HH</td>
<td>1.024 m ha; 1.024 m HH</td>
<td></td>
</tr>
</tbody>
</table>

---

DCLAS PRE-PROPOSAL
<table>
<thead>
<tr>
<th>IN.3.6.4</th>
<th>1.1.1, 1.1.2, 1.3.3, 1.4.1, 2.1.1</th>
<th>At least one variety of <em>pigeonpea</em> released every two years, with (1) at least 10% increased yield over current best variety, OR (2) no yield loss under prevailing abiotic and biotic stress reducing the yield gap by 20%, OR (3) at least 2% improved whole-grain nutrition value (in terms of protein yield and micronutrients), OR (4) at least 10% improved forage/fodder quality/digestibility</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FS2, FS3, FS4</td>
<td>ICRISAT, ICAR, SAUs</td>
</tr>
<tr>
<td></td>
<td>Maharasthra, Karnataka, Andhra Pradesh, Telangana, Uttra Pradesh, Madhya Pradesh, Gujarat, Tamilnadu, Odisha, Rajasthan, Punjab, haryana, 4 M ha, 4.8 M HH</td>
<td></td>
</tr>
<tr>
<td></td>
<td>50000 ha, 60000 HH</td>
<td>100000 Ha, 120000 HH</td>
</tr>
<tr>
<td>IN.3.6.5</td>
<td>1.1.1, 1.1.2, 1.3.3, 1.4.1, 2.1.1</td>
<td>At least one <em>sorghum</em> variety/hybrid released every two years, with (1) at least 10% increased yield (grain and/or stalk) over current best cultivar variety, OR (2) reduced yield loss to shoot fly, Stem borer; Charcoal rot, grain mold and drought OR (3) at least 5% improved whole-grain nutrition value (higher Fe and Zn), OR (4) at least 5% improved forage/fodder yield and animal feed quality/digestibility and the adoption rates of improved cultivars increased by at least 5% every year by large-scale dissemination and developing sustainable seed chain.</td>
</tr>
<tr>
<td></td>
<td>FS2, FS3, FS4</td>
<td>ICRISAT, IIMR, VNMKV, PDKV, MPKV, UAS-D, HPRC partners</td>
</tr>
<tr>
<td></td>
<td>Western Maharasthra, Marathwada, Vidarbha, Northen Karnataka; Total area covered 2.2 m ha; Total number of households benefitted 1.8 m</td>
<td></td>
</tr>
<tr>
<td></td>
<td>100,000 HH; 120,000 ha</td>
<td>200,000 HH; 240,000 ha</td>
</tr>
<tr>
<td></td>
<td>410,000 HH; 500,000 ha</td>
<td>410,000 HH; 500,000 ha</td>
</tr>
<tr>
<td>IN.3.6.6</td>
<td>1.1.1, 1.1.2, 1.3.3, 1.4.1, 2.1.1</td>
<td>At least one variety/hybrid of <em>pearl millet</em> released every two years, with (1) at least 10% increased yield over current best variety, OR (2) improved adaptation to drought stress/ resistance to downy mildew, OR (3) at least 5% improved grain Fe content, OR (4) at least 5% improved forage/fodder quality/digestibility</td>
</tr>
<tr>
<td></td>
<td>FS2, FS3, FS4</td>
<td>ICRISAT</td>
</tr>
<tr>
<td></td>
<td>Rajasthan, Gujarat, Maharashatra, Haryana and UP</td>
<td></td>
</tr>
<tr>
<td></td>
<td>100,000 ha</td>
<td>100,000 ha</td>
</tr>
<tr>
<td>IN.3.6.7</td>
<td>At least one variety of <strong>barley</strong> released every two years, with (1) at least <strong>10% increased yield</strong> over current best variety, OR (2) <strong>no yield loss</strong> under prevailing abiotic and biotic stress reducing the yield gap by 20%, OR (3) at least <strong>2% improved whole-grain nutrition</strong> value (in terms of protein yield and micronutrients), OR (4) at least <strong>10% improved forage/fodder quality/digestibility</strong></td>
<td>FS2, FS3, FS4</td>
</tr>
<tr>
<td>IN.3.6.8</td>
<td>At least one variety/hybrid of <strong>pearl millet</strong> released every two years, with (1) at least <strong>10% increased yield</strong> over current best variety, OR (2) improved adaptation to <strong>drought stress/ resistance to downy mildew</strong>, OR (3) at least <strong>5% improved grain Fe content</strong>, OR (4) at least <strong>5% improved forage/fodder quality/digestibility</strong></td>
<td>FS2, FS3, FS4</td>
</tr>
<tr>
<td>IN.8.2.1</td>
<td>Gender-disaggregated baseline report synthesized from pre-existing data or assembled new</td>
<td>FS1</td>
</tr>
<tr>
<td>IN.8.2.2</td>
<td>Priority-setting based on (1) rural livelihood systems analysis, (2) value-chain analysis; identification of key intervention points</td>
<td>FS1, FS5</td>
</tr>
<tr>
<td>IN.8.2.3</td>
<td>Data delivered on varieties of currently cultivated crop varieties (names, characteristics, year of release and current adoption levels)</td>
<td>FS1</td>
</tr>
</tbody>
</table>
### FLAGSHIP 5: INTEGRATED LAND, WATER & CROP MANAGEMENT

**Country: INDIA**

<table>
<thead>
<tr>
<th>OT Sub-IDO</th>
<th>Outputs; Outcomes</th>
<th>CG Centers, FP links</th>
<th>States</th>
<th>Partners</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
<th>2022 Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>152.1</td>
<td>Sustainable land management/restoration options developed and out scaled</td>
<td>ICRISAT, IWMI, Bioversity, ICARDA</td>
<td>Rajasthan, Karnataka, Maharashtra, Telangana/Andhra Pradesh, Madhya Pradesh</td>
<td>50000 ha of degraded lands reclaimed or halted and increased soil fertility (chemical/biological/physical)</td>
<td>150000 ha of degraded lands reclaimed or halted and increased soil fertility (chemical/biological/physical)</td>
<td>300000 ha of degraded lands reclaimed or halted and increased soil fertility (chemical/biological/physical)</td>
<td>500000 ha of degraded lands reclaimed or halted and increased soil fertility (chemical/biological/physical)</td>
<td>1.5 million ha of degraded lands reclaimed or halted and increased soil fertility (chemical/biological/physical)</td>
<td>2 million families benefit due to restoration/halting of 3 million ha degraded land</td>
<td></td>
<td></td>
</tr>
<tr>
<td>153.1</td>
<td>Integrated management practices for improved crop, water, land &amp; nutrient productivity/efficiency suited to variable and changing climates and farming systems in dryland settings developed and deployed</td>
<td>ICARISAT, ICARDA</td>
<td>Rajasthan, Karnataka, Maharashtra, Telangana/Andhra Pradesh, Madhya Pradesh</td>
<td>10% increases of resources use efficiency &amp; quality over the base yield for the participating farmers</td>
<td>20% increases of resources use efficiency &amp; quality over the first year yield for the participating farmers.</td>
<td>30% increases of resources use efficiency &amp; quality over the 2nd year yield for the participating farmers.</td>
<td>10% increases of resources use efficiency &amp; quality over the 3rd year yield for the participating farmers.</td>
<td>15% increases of resources use efficiency &amp; quality over the 4th year yield for the participating farmers.</td>
<td>15% increases of resources use efficiency &amp; quality over the 5th year yield for the participating farmers.</td>
<td>2 million farm families benefit increase food security due to 50% whole farm productivity increases</td>
<td></td>
</tr>
<tr>
<td>1.5.1</td>
<td>2.1.2, 3.3.2, 3.2.2</td>
<td>Strategies integrating conservation technologies with production solutions to crop and livestock production related constraints validated and implemented</td>
<td>ICRISAT, ILRI</td>
<td>Rajasthan, Karnataka, Maharashtr a, Telangana/ Andhra Pradesh, Madhya Pradesh</td>
<td>10% increase in crop yield due to employing integrated conservation technologies over 1st year</td>
<td>10% increase in crop yield due to employing integrated conservation technologies over 2nd year</td>
<td>10% increase in crop yield due to employing integrated conservation technologies over 3rd year</td>
<td>10% increase in crop yield due to employing integrated conservation technologies over 4th year</td>
<td>About 2 million farmers will increase their crop yield by 50% through employing integrated conservation technologies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.5.2</td>
<td>2.1.2, 3.3.2, 3.2.2</td>
<td>Production systems diversified and intensified through suitable expansion of cropping systems, including vegetables and multiple purpose trees, livestock and fish</td>
<td>ICRISAT, ICARDA, ILRI</td>
<td>Rajasthan, Karnataka, Maharashtr a, Telangana/ Andhra Pradesh, Madhya Pradesh</td>
<td>Participating households increased access to nutritious food by 10% and income increased by 20%</td>
<td>Participating households increased access to nutritious food by 10% and income increased by 20% over 1st year</td>
<td>Participating households increased access to nutritious food by 10% and income increased by 20% over 2nd year</td>
<td>Participating households increased access to nutritious food by 10% and income increased by 20% over 3rd year</td>
<td>Participating households increased access to nutritious food by 10% and income increased by 20% over 4th year</td>
<td>1 million farm families increased access to nutritious food by 50% and income increased by 150%</td>
<td></td>
</tr>
<tr>
<td>1.5.3</td>
<td>3.3.3, 2.4.3, 2.3.1, 2.1.2, 1.3.4</td>
<td>Appropriate mechanization and agri-informatics for precision agriculture assessed for more efficient use of NRs, labor, inputs and energy by stallholder farmers and implemented at farm scale</td>
<td>ICRISAT</td>
<td>Rajasthan, Karnataka, Maharashtr a, Telangana/ Andhra Pradesh, Madhya Pradesh</td>
<td>50,000 women and men farmers participating in piloting modern mechanization at their farms. At least two labor saving technical schemes</td>
<td>100,000 women and men farmers participating in piloting modern mechanization at their farms. At least two labor saving technical schemes</td>
<td>200,000 women and men farmers participating in piloting modern mechanization at their farms. At least two labor saving technical schemes</td>
<td>300,000 women and men farmers adapt some form of mechanization at their farms. At least two labor saving technical schemes</td>
<td>1 million farm families benefit increased food security due to 50% increase in farm productivity and resilience and cost reduction</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
I.5.6.1 Economically viable integrated Pest (including diseases and weeds) Management strategies for reducing chemical and antibiotics use and enhance crop and livestock biodiversity in the ecosystem developed and deployed

FP5, FP3, FP2, NARES, NGOs, private sector

Sates: Rajasthan, Karnataka, Maharashtra, Telangana/Andhra Pradesh, Madhya Pradesh

50'000 women and men farmers participating in IPM (+weeds) package with eco-friendly methods and increase of productivity/resilience to CC

150'000 women and men farmers participating in IPM (+weeds) package with eco-friendly methods and increase of productivity/resilience to CC

300'000 women and men farmers participating in IPM (+weeds) package with eco-friendly methods and increase of productivity/resilience to CC

400'000 women and men farmers participating in IPM (+weeds) package with eco-friendly methods and increase of productivity/resilience to CC

500'000 women and men farmers participating in IPM (+weeds) package with eco-friendly methods and increase of productivity/resilience to CC

1 m women and men families benefit by substituting 50% chemicals by eco-friendly methods and 50% increase in productivity/resilience to CC and reduction of negative impact of chemicals

FLAGSHIP 6: IMPROVED RURAL LIVELIHOOD SYSTEMS

Country: INDIA

OT Sub-IDO Outputs; Outcomes FP links CG Centers Partners Regions 2017 2018 2019 2020 2021 2022 2022 Outcome

IN.6.1.1 Enabling cluster (see narrative). Farmers offered more effective livelihood options for systems intensification and optimization

FP 6 C6.1 (FP1 - Jointly developed typologies; contribution to foresight studies). (FP5 - calibration of landscape scale models)

ILRI, ICRAF, CIAT, ICRISAT, Bioversity, Systems FPs in other CRPs

WUR, CSIRO, NARS 297319 (1000 Ha) Appropriately livelihood systems simulation and trade-off models identified 10 Ex ante impact assessments (disaggregate d by system / household type) completed 10 portfolios of options for improving livelihoods established Continuous refinement of model definition and livelihood portfolios Livelihood systems / household types analysed across 10 field sites 5000 farmers offered more effective livelihood options for systems intensification and optimization

DCLAS PRE-PROPOSAL
| IN.6.2.1 | 1.1.2., 1.3.2., 1.3.4., 1.4.2., 2.1.1., 2.1.2., 3.3.3., B.1.1., B.1.2. | Tested, adapted and validated options applied for SI and livelihood diversification applied by farmers | FP 6 C6.2 (FP1 - align stakeholder platforms with diagnostic studies). (FP2 - livelihood impacts of loss reduction / value addition, improved germplasm). (FP4 - testing at landscape scale) | ICRISAT, ILRI, AVRDC, Livestock, Bioversity, FTE, Other AFS, CCAFS, A4NH | 10 multi-stakeholder platforms and farmer research groups established | Continuous adaptation and refinement of livelihood systems portfolios | Tested, validated and adapted options applied for SI and livelihood diversification applied by 25000 farmers |
| IN.6.3.1 | 3.1.3., 3.2.3., 3.2.3., A.1.1., A.1.4. | Identify strategies (portfolio revision, governance options) for mitigation of negative impacts at scale | FS 6 C6.3 (FP4 - testing at landscape scale) | ICRISAT, ILRI, CIAT, IITA, WLSE, Bioversity, | Establish monitoring of aggregated impacts of applied livelihood portfolios in 10 sample watersheds / landscapes | Identify positive and negative interactions at landscape scale | Strategies (portfolio revision, governance options) for mitigation of negative impacts at scale identified (across 10 watersheds) |
| IN.6.4.1 | C.1.1., D.1.4. | Development partners implement programs with increased adoption rates of improved livelihood strategies | FS 6 C6.4 (FP1 - MEL of scaling initiatives). (FP7 - prioritisation for value addition) | ICRISAT, ILRI, ICRAF, CIAT, IITA, WLSE, PIM, Bioversity, | Review of cases of successful and failed innovation adoption taking the social-ecological system context into account | Development of a systems framework for agricultural innovation adoption | Assessing the impact of pilot studies and establishment of co-investment programmes for scaling |

DCLAS PRE-PROPOSAL
Governance mechanisms are revised and harmonized in a way that encourages improved livelihood strategies that are adapted to various dryland contexts.
<table>
<thead>
<tr>
<th>OT</th>
<th>Sub-IDOs</th>
<th>Outputs; Outcomes</th>
<th>FP links</th>
<th>CG Centers</th>
<th>Partners</th>
<th>20.17</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
</tr>
</thead>
<tbody>
<tr>
<td>I.7.1.1</td>
<td>1.2.2, 1.3.3, B.1.2, C.1.1</td>
<td>20 technologies identified, refined and transferred to small scale processors</td>
<td>FS1, FS6</td>
<td>NARS, NGOs, Extension, private sector</td>
<td>3</td>
<td>5</td>
<td>10</td>
<td>15</td>
<td>18</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>I.7.1.2</td>
<td>1.2.2, 1.3.3, B.1.2, C.1.1</td>
<td>250 potential entrepreneurs trained on these technology based businesses</td>
<td>25</td>
<td>50</td>
<td>100</td>
<td>150</td>
<td>200</td>
<td>250</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I.7.1.3</td>
<td>1.2.2, 1.3.3, B.1.2, C.1.1</td>
<td>100 entrepreneurs supported for running their business on the mandated crops</td>
<td>10</td>
<td>20</td>
<td>30</td>
<td>50</td>
<td>80</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I.7.2.1</td>
<td>1.3.2, 1.3.3, B.1.2, 1.4.1, C.1.1</td>
<td>at least 10 post harvest and storage technologies identified</td>
<td>FS6, FS3</td>
<td>IITA, ICRISAT, ICRAF</td>
<td>NARS, NGOs, Extension, private sector</td>
<td>5</td>
<td>5</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I.7.2.2</td>
<td>1.3.2, 1.3.3, B.1.2, 1.4.1, C.1.1</td>
<td>At least 15 equipment manufacturers engaged for uptake and commercialization</td>
<td>4</td>
<td>8</td>
<td>10</td>
<td>12</td>
<td>15</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I.7.2.3</td>
<td>1.3.2, 1.3.3, B.1.2, 1.4.1, C.1.1</td>
<td>Post harvest losses reduced by 10%</td>
<td>2</td>
<td>5</td>
<td>8</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I.7.2.4</td>
<td>1.3.2, 1.3.3, B.1.2, 1.4.1, C.1.1</td>
<td>10000 farmers adopt new technologies to reduce post harvest</td>
<td>3000</td>
<td>5000</td>
<td>8000</td>
<td>10000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I.7.3.1</td>
<td>2.1.1, 2.1.2, 2.1.3, 1.3.1, 1.3.2</td>
<td>At least 5 Food products formulated using locally available crops for addressing malnutrition, hidden hunger and lifestyle diseases</td>
<td>FS1, FS6, FS3</td>
<td>IITA, ICRISAT, ICRAF</td>
<td>NARS, NGOs, Extension, private sector</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>I.7.3.2</td>
<td>2.1.1, 2.1.2, 2.1.3, 1.3.1, 1.3.2</td>
<td>Increase the usage of traditional crops of feed industry towards adaptation across livestock and allied sectors by 10%</td>
<td>5</td>
<td>7</td>
<td>8</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I.7.3.3</td>
<td>2.1.1, 2.1.2, 2.1.3, 1.3.1, 1.3.2</td>
<td>10% adoption of new formulations / products by industry and local population</td>
<td>5</td>
<td>7</td>
<td>8</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I.7.4.1</td>
<td>D.1.1, C.1.1, 1.3.2, 1.3.3</td>
<td>At least two marketing strategies their respective value chain actors developed and adopted</td>
<td>FS1, FS6</td>
<td>ICRAF, IITA, ICRISAT</td>
<td>Private sector, NGO, Extension</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I.7.4.2</td>
<td>D.1.1, C.1.1, 1.3.2, 1.3.3</td>
<td>At least 10 value chain actors adopting any of the mandate crops / crop based technologies</td>
<td>2</td>
<td>5</td>
<td>8</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I.7.4.3</td>
<td>D.1.1, C.1.1, 1.3.2, 1.3.3</td>
<td>Income of farmers and small scale processors increased by 20%</td>
<td>5</td>
<td>10</td>
<td>12</td>
<td>15</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I.7.4.4</td>
<td>D.1.1, C.1.1, 1.3.2, 1.3.3</td>
<td>Quantity of products sold for value chain actors increased by 20%</td>
<td>5</td>
<td>10</td>
<td>15</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I.7.5.1</td>
<td>1.3.2, 1.3.3, B1.3, D.1.2, D.1.2</td>
<td>Establishment of 3 DCLAS food processing and food safety business incubation facility</td>
<td>FS1</td>
<td>ICRISAT, ICRAF, IITA</td>
<td>FARA, private sector</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I.7.5.2</td>
<td>1.3.2, 1.3.3, B1.3, D.1.2, D.1.2</td>
<td>100 start-up entrepreneurs (including women &amp; youth) supported in the area of agri and food business</td>
<td>FS1</td>
<td>ICRISAT, ICRAF, IITA</td>
<td>Private sector</td>
<td>15</td>
<td>30</td>
<td>50</td>
<td>75</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>I.7.5.3</td>
<td>1.3.2, 1.3.3, B1.3, D.1.2, D.1.2</td>
<td>100 entrepreneurs made to grow (increase in sales) by average 20%</td>
<td>FS1</td>
<td>ICRISAT, ICRAF, IITA</td>
<td>Private sector</td>
<td>25</td>
<td>50</td>
<td>75</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I.7.5.4</td>
<td>1.3.2, 1.3.3, B1.3, D.1.2, D.1.2</td>
<td>500 youth &amp; women trained in the area of agribusiness</td>
<td>FS1</td>
<td>ICRISAT, ICRAF, IITA</td>
<td>Private sector</td>
<td>50</td>
<td>100</td>
<td>200</td>
<td>300</td>
<td>400</td>
<td>500</td>
</tr>
<tr>
<td>I.7.6.1</td>
<td>D.1.1, D.1.1, D.1.1, D.1.3, B.1.3, 1.2.2</td>
<td>10 Public-private partnership facilitated with scientists for technology access</td>
<td>FS3</td>
<td>ICRISAT, ICRAF, IITA</td>
<td>Private sector</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>5</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>I.7.6.2</td>
<td>D.1.1, D.1.1, D.1.1, D.1.3, B.1.3, 1.2.2</td>
<td>100 existing medium and large scale industries linked for technologies and market access</td>
<td>FS3</td>
<td>ICRISAT, ICRAF, IITA</td>
<td>Private sector</td>
<td>10</td>
<td>15</td>
<td>30</td>
<td>60</td>
<td>80</td>
<td>100</td>
</tr>
<tr>
<td>I.7.6.3</td>
<td>D.1.1, D.1.1, D.1.1, D.1.3, B.1.3, 1.2.2</td>
<td>1000 youth trained on business development skills</td>
<td>FS3</td>
<td>ICRISAT, ICRAF, IITA</td>
<td>Private sector</td>
<td>100</td>
<td>200</td>
<td>500</td>
<td>700</td>
<td>800</td>
<td>1000</td>
</tr>
<tr>
<td>I.7.6.4</td>
<td>D.1.1, D.1.1, D.1.1, D.1.3, B.1.3, 1.2.2</td>
<td>500,000 farmers benefiting by facilitating market access through contract farming and market linkages</td>
<td>200000</td>
<td>300000</td>
<td>400000</td>
<td>500000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OT</td>
<td>Sub-IDO</td>
<td>Outputs; Outcomes</td>
<td>2017</td>
<td>2018</td>
<td>2019</td>
<td>2020</td>
<td>2021</td>
<td>2022</td>
<td>2022 Outcome</td>
<td></td>
<td></td>
</tr>
<tr>
<td>----</td>
<td>---------</td>
<td>-------------------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>---------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N.1.1.1</td>
<td>through other FPs</td>
<td>Prioritization principles established and agreed amongst DCLAS FPs based on analysis of existing gender disaggregated data and planned DCLAS activities for improved efficiency of research investments in Nigeria</td>
<td>Prioritization principles established and agreed based on analysis of existing gender disaggregated data and planned DCLAS activities in Nigeria</td>
<td>Options testing analysed and lessons incorporated for prioritization principles and continuous implementation in Nigeria</td>
<td>Continued application of prioritization principles and effectiveness and efficiency demonstrated in Nigeria</td>
<td>Continued application of the prioritization principles and (adjusted where required) effectiveness and efficiency demonstrated in Nigeria</td>
<td>Continued application of the prioritization principles and (adjusted where required) effectiveness and efficiency demonstrated in Nigeria</td>
<td>More targeted research across DCLAS in Nigeria and beyond. Increased efficiency and effectiveness in DCLAS use of human and financial resources in the target areas</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N.1.2.1</td>
<td>1.2.2</td>
<td>Inclusive value chains support mechanisms and scaling options in place in Nigeria</td>
<td>1 value chain assessment in progress</td>
<td>1 value chain assessed for its inclusiveness and growth potential and best fit solution identified</td>
<td>1 value chain assessed for its inclusiveness and growth potential. At least 1 best fit solutions scaled through partnerships</td>
<td>1 value chain assessed for its inclusiveness and growth potential. At least 1 best fit solutions scaled through partnerships</td>
<td>1 value chain assessed for its inclusiveness and growth potential. At least 1 best fit solutions scaled through partnerships</td>
<td>At least 4 value chains (incl sorghum, millet, cowpea, ground nuts) assessed for its inclusiveness and growth potential in Nigeria and beyond and at least 4 best fit solutions scaled through partnerships</td>
<td>At least 4 value chains (incl sorghum, millet, cowpea, ground nuts) assessed for its inclusiveness and growth potential in Nigeria and beyond and at least 4 best fit solutions scaled through partnerships</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N.1.3.1</td>
<td>1.1.2</td>
<td>Prioritized options adjusted for climate change and other long term risks in target areas of Nigeria</td>
<td>Future climate and risk profiles outlined for targeted dryland areas in Nigeria and made available for DCLAS researchers and partners use</td>
<td>Ex-ante assessment mechanisms for FP2, 3 and 5 and priorities established and adapted to the target areas in Nigeria</td>
<td>1 priority option assessed for its long term suitability across likely future scenarios for the targeted areas in Nigeria and beyond</td>
<td>1 priority option assessed for its long term suitability across likely future scenarios for the targeted areas in Nigeria and beyond</td>
<td>1 priority option assessed for its long term suitability across likely future scenarios for the targeted areas in Nigeria and beyond</td>
<td>1 priority option assessed for its long term suitability across likely future scenarios for the targeted areas in Nigeria and beyond</td>
<td>At least 4 prioritized options adjusted for climate change and other long term risks in target areas in Nigeria and beyond</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N.1.4.1</td>
<td>B.1.3</td>
<td>Inclusive innovation system established supporting women and young people empowerment in target areas of Nigeria</td>
<td>1 inclusive innovation system for women and 1 for young people functioning and underlying design principles proven (partners trained under outcome CapDev where required). Operating around women farmer groups (3<em>50) and youth groups (3</em>50) in target areas in Nigeria</td>
<td>2 inclusive innovations system across contexts running in the target areas in Nigeria and principles validated/adjusted (partners trained under outcome CapDev where required)</td>
<td>2 functioning innovation systems established across DCLAS sites in Nigeria and sustainably operating. Initiation of scaling out process through partners targeting 5 new innovation systems in the target areas in Nigeria and beyond</td>
<td>2 functioning innovation systems established across DCLAS sites in Nigeria and sustainably operating. Initiation of scaling out process through partners targeting 5 new innovation systems in the target areas in Nigeria and beyond</td>
<td>7 functioning innovation systems established across DCLAS sites in Nigeria and sustainably operating. Continuing scaling out process through partners targeting 5 new innovation systems in the target areas in Nigeria and beyond</td>
<td>12 functioning innovation systems established across DCLAS sites in Nigeria and sustainably operating through partners (2 per state)</td>
<td>At least 12 inclusive innovation systems supporting women and youth empowerment functional and sustainably operating through partners (at least 2 per targeted Nigerian states)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Section</td>
<td>Description</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------</td>
<td>-------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C.1.1</td>
<td>Diverse farmer typology established for the target areas in Nigeria, drivers of adoption identified and implications for policy interventions to reach impact at scale assessed.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N.1.5.1</td>
<td>Diversity of farmer present and future demands by context outlined based on pre-existing and new survey gender disaggregated data in view of research and partnership in DCLAS in the target areas of Nigeria.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N.1.6.1</td>
<td>Scaling out options tested in target areas in Nigeria and beyond and assessed for impact in collaboration with stakeholders.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.3.2</td>
<td>Monitoring, evaluation and learning (ME&amp;L) framework designed and implemented across DCLAS sites in Nigeria with specific reference to options by context testing and later impact assessment in target areas and beyond.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.3.2</td>
<td>Partnership network and mechanisms for engagement in ME&amp;L and scaling established and functioning in targeted areas in Nigeria. Option testing supported.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.3.2</td>
<td>Options tested across heterogenous conditions (different contexts) for its potential impact across DCLAS sites in Nigeria and beyond.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.3.2</td>
<td>1 scaled option assessed for its early impact across DCLAS target sites in Nigeria including spill overs in the region (W Africa).</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.3.2</td>
<td>Detailed feedback from impact assessment for DCLAS in target areas in Nigeria and stakeholder learning and 2-way strategic adjustments.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.3.2</td>
<td>1 scaled option assessed for its early impact across DCLAS target sites in Nigeria including spill overs in the region (W Africa).</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.3.2</td>
<td>Dryland communities in target areas in Nigeria more integrated in the wider economies.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Improved match of technologies to farmer demands and realities/contexts across target areas in Nigeria and the region.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D.1.4</td>
<td>Integration of decision makers and end-users along the research process for better grounded interventions in Nigeria and beyond</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N.1.0.1</td>
<td>Most relevant decision makers and end-users (stakeholders) identified trained, and integrated in priority setting and planning process at target site (state) and Nigeria country level</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N.1.4.2</td>
<td>Early assessment of stakeholder involvement, ownership and mutual learning at target site and Nigeria country level</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N.1.4.2</td>
<td>Platforms for continuous prioritization and feed-back and learning functional in target sites (states) in Nigeria</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N.1.4.2</td>
<td>Platforms for continuous prioritization and feed-back and learning functional and locally driven in target sites (states) in Nigeria</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N.1.4.2</td>
<td>Platforms for continuous prioritization and feed-back and learning functional and locally driven in target sites (states) in Nigeria</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| D.1.2 | Capacities of women, men and young people for the specific needs and methods for the dryland agriculture development agendas enhanced in partner agencies in Nigeria and beyond |
| N.1.4.2 | Capacity gaps identified and local action plans for inclusive innovation systems agreed for target sites in Nigeria, including upgrading existing capacities or enabling additional capacities to develop |
| N.1.4.2 | Support for the trained trainers in implementing their work plans in target sites in Nigeria: training of women and youth groups in innovation systems and facilitate the innovation platforms |
| N.1.4.2 | Assess the lessons learnt from training and implementation, and fine-tune the training curricula to be available on-line (open access). A balanced (male - female, young - old, regional and cultural) set of 10 facilitators trained (training of trainers) in target areas in Nigeria |
| N.1.4.2 | Assessing the process and set up sustainable functional and independent implementation plan for facilitation and spread of training of women and youth facilitators supporting innovation systems and platforms in target sites in Nigeria |
| N.1.4.2 | Monitoring the progress and best practices for facilitation and spread of training of women and youth facilitators supporting innovation systems and platforms in target sites in Nigeria |
| N.1.4.2 | Integration of stakeholders in at least 12 inclusive innovation platforms for long-term ownership and capacity in target sites in Nigeria and beyond |
## Outputs; Outcomes

<table>
<thead>
<tr>
<th>OT</th>
<th>Sub-IDO</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
</tr>
</thead>
<tbody>
<tr>
<td>N.3.6.1.1</td>
<td>1.1.1, 1.1.2, 1.3.3, 1.3.1, 1.4.1, 2.1.1</td>
<td>At least one variety of cowpea released every two years, with (1) at least 10% increased yield over current best variety, OR (2) 15% less yield loss under prevailing drought, low fertility, insect or Striga stress OR (3) at least 5% improved forage/fodder quantity</td>
<td>IAR; KNARDA; KATARDA; JARDA; Bauchi ADP; UAM; UC Riverside; Legume Innovation Lab;</td>
<td>Borno (288,000 ha); Bauchi (149,000 ha); Jigawa (33,000 ha); Katsina (43,400 ha); Sokoto (36,000 ha); Kano (124,000 ha)</td>
<td>30,000 ha; 120,000 HH</td>
<td>2 varieties released; 35,000 ha; 140,000 ha</td>
<td>40,000 ha; 160,000 HH</td>
</tr>
<tr>
<td>N.3.6.1.2</td>
<td>1.1.1, 1.1.2, 1.3.3, 1.3.1, 1.4.1, 2.1.1</td>
<td>At least one variety of soybean released every two years, with (1) at least 10% increased yield over current best variety, OR (2) 10% less yield loss under prevailing drought, low fertility, rust OR (3) at least 5% improved forage/fodder quantity</td>
<td>IITA</td>
<td>NCRI; KNARDA; KATARDA; UAM; U. Illinois; Soybean Innovation Lab</td>
<td>Kano (46,900 ha); Kaduna (67,900 ha); Benue (118,900 ha)</td>
<td>13,000 ha; 52,000 HH</td>
<td>2 varieties released; 16,000 ha; 64,000 HH</td>
</tr>
<tr>
<td>N.3.6.1.3</td>
<td>1.1.1, 1.1.2, 1.3.3, 1.3.1, 1.4.1, 2.1.1</td>
<td>At least one variety of pearl millet released every two years, with (1) at least 10% increased yield over current best variety, OR (2) 15% less yield loss under prevailing abiotic and downy mildew stress, OR (3) at least 15% improved whole-grain nutrition value (to be defined), OR (4) at least 5% improved forage/fodder quantity</td>
<td>ICRISAT</td>
<td>UDUS; KNARDA; GSARDI; KATARDA; Kebbi ADP; Zamfara ADP; JARDA; Yobe ADP; Borno ADP; Seed entrepise in the same states; WOFAN</td>
<td>100,000 ha; 400,000 HH</td>
<td>2 varieties released; 100,000 ha; 400,000 HH</td>
<td>100,000 ha; 400,000 HH</td>
</tr>
</tbody>
</table>
At least one variety of **groundnut** released every two years, with (1) at least 10% increased yield over current best variety, OR (2) **15% less yield loss reduced** under prevailing drought, low fertility, insect, rosette or rust stress OR (3) at least 5% improved forage/fodder quantity or (4) at least 2% improved whole-grain nutrition value (in terms of oil yield and quality and micronutrients)

| N.3.6.1.4 | At least one variety of **groundnut** released every two years, with (1) at least 10% increased yield over current best variety, OR (2) **15% less yield loss reduced** under prevailing drought, low fertility, insect, rosette or rust stress OR (3) at least 5% improved forage/fodder quantity or (4) at least 2% improved whole-grain nutrition value (in terms of oil yield and quality and micronutrients) | 2.36 m ha; 9.44 HH; Kano, Katsina, Kaduna, Jigawa, Sokoto, Zamfara, Kebbi, Adamawa, Bauchi, Yobe, Borno, Benue, Plateau, Taraba, Nasarawa, FCT Abuja, Kogi, Niger, Kwara | 500 ha; 1,500 HH | 2,000 ha; 6,000 HH | 8,000 ha; 24,000 HH | 16,000 ha; 52,000 HH | 25,000 ha; 75,000 HH | 40,000 ha; 120,000 HH |

At least one variety of **sorghum** released every two years, with (1) at least 10% increased yield over current best variety, OR (2) **20% less yield loss reduced** under prevailing abiotic and Striga or stem borer stress, OR (3) at least 10% greater iron concentration (with A4NH), OR (4) at least 5% improved fodder quantity

| N.3.6.1.5 | At least one variety of **sorghum** released every two years, with (1) at least 10% increased yield over current best variety, OR (2) **20% less yield loss reduced** under prevailing abiotic and Striga or stem borer stress, OR (3) at least 10% greater iron concentration (with A4NH), OR (4) at least 5% improved fodder quantity | 100,000 ha; 400,000 HH | 2 varieties released; 100,000 ha; 400,000 HH | 100,000 ha; 400,000 HH | 2 varieties released; 100,000 ha; 400,000 HH | 100,000 ha; 400,000 HH | 2 varieties released; 100,000 ha; 400,000 HH | 100,000 ha; 400,000 HH | 2 varieties released; 100,000 ha; 400,000 HH |

Gender-disaggregated baseline report synthesized from pre-existing data or assembled new

| N.8.2.1 | Gender-disaggregated baseline report synthesized from pre-existing data or assembled new | FS1 | x |

Priority-setting based on (1) rural livelihood systems analysis, (2) value-chain analysis; identification of key intervention points

| N.8.2.2 | Priority-setting based on (1) rural livelihood systems analysis, (2) value-chain analysis; identification of key intervention points | FS1, FS5 | x |

Data delivered on varieties of currently cultivated cowpea, pearl millet and sorghum (names, characteristics, year of release and current adoption levels)

<p>| N.8.2.3 | Data delivered on varieties of currently cultivated cowpea, pearl millet and sorghum (names, characteristics, year of release and current adoption levels) | FS1 | x |</p>
<table>
<thead>
<tr>
<th>OT</th>
<th>Sub-IDO</th>
<th>Outputs; Outcomes</th>
<th>CG Centers</th>
<th>States</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
<th>2022 Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>N.5.2.1</td>
<td>3.3.2, 3.1.1, 4.1.2</td>
<td>Sustainable land management/restoration options developed and out scaled</td>
<td>ICRISAT, CIAT, Bioversity</td>
<td>Kaduna, Kano, Kasthina, Jigawa, Zamfara, Sokoto</td>
<td>10000 ha of degraded lands reclaimed or halted. 10000 ha increased soil fertility (chemical/biological/physical)</td>
<td>10000 ha of degraded lands reclaimed or halted. 10000 ha increased soil fertility (chemical/biological/physical)</td>
<td>50000 ha of degraded lands reclaimed or halted. 10000 ha increased soil fertility (chemical/biological/physical)</td>
<td>50000 ha of degraded lands reclaimed or halted. 10000 ha increased soil fertility (chemical/biological/physical)</td>
<td>100000 ha of degraded lands reclaimed or halted. 10000 ha increased soil fertility (chemical/biological/physical)</td>
<td>200000 ha of degraded lands reclaimed or halted. 200000 ha increased carbon sequestration</td>
<td>500000 families benefit from degraded land (400000 ha) restoration/halting</td>
</tr>
<tr>
<td>N.5.3.1</td>
<td>1.1.2, 1.3.2, 1.3.4, 2.1.2</td>
<td>Integrated management practices for improved crop, water, land &amp; nutrient productivity/efficiency suited to variable and changing climates and farming systems in dryland settings developed and deployed</td>
<td>ICRISAT, IITA</td>
<td>Kaduna, Kano, Kasthina, Jigawa, Zamfara, Sokoto</td>
<td>10% increases of resources use efficiency &amp; quality over the base yield for the participating farmers</td>
<td>20% increases of resources use efficiency &amp; quality over the first year yield for the participating farmers</td>
<td>30% increases of resources use efficiency &amp; quality over the 2nd year yield for the participating farmers</td>
<td>10% increases of resources use efficiency &amp; quality over the 3rd year yield for the participating farmers.</td>
<td>15% increases of resources use efficiency &amp; quality over the 4th year yield for the participating farmers.</td>
<td>15% increases of resources use efficiency &amp; quality over the 5th year yield for the participating farmers.</td>
<td>500000 farm families benefit increase food security due to 50% whole farm productivity increases</td>
</tr>
<tr>
<td>N.5.4.1</td>
<td>2.1.2, 3.3.2, 3.2.2</td>
<td>Strategies integrating conservation technologies with production solutions to crop and livestock production related constraints validated and implemented</td>
<td>ICRISAT, ILRI</td>
<td>Kaduna, Kano, Kasthina, Jigawa, Zamfara, Sokoto</td>
<td>5% increase in crop yield due to employing integrated conservation technologies over 1st year</td>
<td>10% increase in crop yield due to employing integrated conservation technologies over 2nd year</td>
<td>10% increase in crop yield due to employing integrated conservation technologies over 3rd year</td>
<td>10% increase in crop yield due to employing integrated conservation technologies over 4th year</td>
<td>15% increases in crop yield due to employing integrated conservation technologies over 5th year</td>
<td>200000 farm families will increase their crop yield by 50% through employing integrated conservation technologies</td>
<td></td>
</tr>
<tr>
<td>N.5.4.1</td>
<td>2.1.2, 3.3.2, 3.2.2</td>
<td>Production systems diversified and intensified through suitable expansion of cropping systems, including vegetables and multiple purpose trees, livestock and fish</td>
<td>ICRISAT, IITA, ILRI</td>
<td>NARES, NGO’s, private sector, FP5, FP6, FP2</td>
<td>Participating households increased access to nutritious food by 10% and income increased by 10%</td>
<td>Participating households increased access to nutritious food by 10% and income increased by 20% over 1st year</td>
<td>Participating households increased access to nutritious food by 10% and income increased by 50% over 2nd year</td>
<td>Participating households increased access to nutritious food by 10% and income increased by 20% over 3rd year</td>
<td>Participating households increased access to nutritious food by 10% and income increased by 20% over 4th year</td>
<td>Participating households increased access to nutritious food by 10% and income increased by 20% over 5th year</td>
<td>200000 farm families increased access to nutritious food by 50% and income increased by 100%</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>N.5.5.1</td>
<td>3.3.3, 2.4.3, 2.3.1, 2.1.2, 1.3.4</td>
<td>Appropriate mechanization and agri-informatics for precision agriculture assessed for more efficient use of NRs, labor, inputs and energy by stallholder farmers and implemented at farm scale</td>
<td>ICRISAT, IITA</td>
<td>NARES, NGO’s, private sector, FP5, FP7, FP2</td>
<td>Sates: Kaduna, Kano, Katshina, Jigawa, Zamfara, Sokoto</td>
<td>5000 women and men farmers participating in piloting modern mechanization at their farms. At least two labor saving technical schemes</td>
<td>25,000 women and men farmers participating in piloting modern mechanization at their farms. At least two labor saving technical schemes</td>
<td>50,000 women and men farmers participating in piloting modern mechanization at their farms. At least two labor saving technical schemes</td>
<td>100,000 women and men farmers participating in piloting modern mechanization at their farms. At least two labor saving technical schemes</td>
<td>150,000 women and men farmers participating in piloting modern mechanization at their farms. At least two labor saving technical schemes</td>
<td>200000 women and men farmers adapt some form of mechanization at their farms. At least two labor saving technical schemes</td>
</tr>
<tr>
<td>N.5.6.1</td>
<td>2.1.1, 3.3.1, 3.1.2, 2.3.1</td>
<td>Economically viable integrated Pest (including diseases and weeds) Management strategies for reducing chemical and antibiotics use and enhance crop and livestock biodiversity in the ecosystem developed and deployed</td>
<td>ICRISAT, IITA</td>
<td>NARES, NGO’s, private sector, FP5, FP4, FP2</td>
<td>Sates: Kaduna, Kano, Katshina, Jigawa, Zamfara, Sokoto</td>
<td>10’000 women and men farmers participating in IPM (+weeds) package with eco friendly methods and increase of productivity/resilience to CC</td>
<td>20’000 women and men farmers participating in IPM (+weeds) package with eco friendly methods and increase of productivity/resilience to CC</td>
<td>50’000 women and men farmers participating in IPM (+weeds) package with eco friendly methods and increase of productivity/resilience to CC</td>
<td>100’000 women and men farmers participating in IPM (+weeds) package with eco friendly methods and increase of productivity/resilience to CC</td>
<td>200’000 women and men farmers participating in IPM (+weeds) package with eco friendly methods and increase of productivity/resilience to CC</td>
<td>500’000 women and men farmers participating in IPM (+weeds) package with eco friendly methods and increase of productivity/resilience to CC</td>
</tr>
</tbody>
</table>
### Flagship 6: Improved Rural Livelihood Systems

**Country:** Nigeria

<table>
<thead>
<tr>
<th>OT Sub-IDO</th>
<th>Outputs; Outcomes</th>
<th>FP links</th>
<th>CG Centers</th>
<th>Partners</th>
<th>Regions</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
<th>2022 Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>NG.6.1.1</td>
<td>Farmers offered more effective livelihood options for systems intensification and optimization</td>
<td>FP 6 C6.1 (FP1 - Jointly developed typologies; contribution to foresight studies). (FP5 - calibration of landscape scale models)</td>
<td>ILRI, ICRAF, CIAT, ICRISAT, ICARDA, Bioversity Systems FPs in other CRPs</td>
<td>[WEUR, CSIRO, NARS] 91077 (1000 Ha)</td>
<td>Appropriate livelihood systems simulation and tradeoff models identified</td>
<td>10 Ex ante impact assessments (disaggregate d by system / household type) completed</td>
<td>10 portfolios of options for improving livelihoods established</td>
<td>Continuous refinement of model definition and livelihood portfolios</td>
<td>Livelihood systems / household types analysed across 10 field sites</td>
<td>5000 farmers offered more effective livelihood options for systems intensification and optimization</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NG.6.2.1</td>
<td>Tested, adapted and validated options applied for SI and livelihood diversification applied by farmers</td>
<td>FP 6 C6.2 (FP1 - align stakeholder platforms with diagnostic studies). (FP2 - livelihood impacts of loss reduction / value addition, improved germplasm). (FP4 - testing at landscape scale)</td>
<td>ICRISAT, ILRI, ICRAF, IITA, AVRDC, Livestock, FTE, Other AFS, CCAFS, A4NH</td>
<td>[NARS, Development partners] 25 (1000ha)</td>
<td>10 multi-stakeholder platforms and farmer research groups established</td>
<td>Protfolios evaluated and option combinations selected by 5000 participating core households</td>
<td>Continuous adaptation and refinement of livelihood systems portfolios</td>
<td>Livelihood options tested, adapted and validated across 10 field sites</td>
<td>Tested, validated and adapted options applied for SI and livelihood diversification applied by 25000 farmers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NG.6.3.1</td>
<td>Identify strategies (portfolio revision, governance options) for mitigation of negative impacts at scale</td>
<td>FS 6 C6.3 (FP4 - testing at landscape scale)</td>
<td>ICRISAT, ILRI, ICRAF, CIAT, IITA, WLSE</td>
<td>[NARS, Development partners] 50 (1000ha)</td>
<td>Establish monitoring of aggregated impacts of applied livelihood portfolios in 10 sample watersheds / landscapes</td>
<td>Identify positive and negative interactions at landscape scale</td>
<td>Strategies (portfolio revision, governance options) for mitigation of negative impacts at scale identified (across 10 watersheds)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NG6.4.1</td>
<td>C.1.1., D.1.4.</td>
<td>Development partners implement programs with increased adoption rates of improved livelihood strategies</td>
<td>FS 6 C6.4 (FP1 - MEL of scaling initiatives). (FP7 - prioritisation for value addition)</td>
<td>ICRISAT, ILRI, ICRAF, CIAT, IITA, WLSE, PIM</td>
<td>NARS, Development Partners 1,000 (1,000 ha)</td>
<td>Review of cases of successful and failed innovation adoption taking the social-ecological system context into account</td>
<td>Development of a systems framework for agricultural innovation adoption</td>
<td>Empirical testing of hypotheses regarding the influence of system features on innovation adoption</td>
<td>Piloting different up-and out-scaling approaches with development partners</td>
<td>Assessing the impact of pilot studies and establishment of co-investment programmes for scaling</td>
<td>2 development partners implement programs with increased adoption rates of improved livelihood strategies</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>NG6.5.1</td>
<td>1.1.2., C.1.2., D.1.1.</td>
<td>Governance mechanisms are revised and harmonized in a way that encourages improved livelihood strategies that are adapted to various dryland contexts</td>
<td>FS 6 6.5D (FP1 - ?). (FP3 - ?). (FP6 - ?)</td>
<td>ICRISAT, ILRI, ICRAF, CIAT, IITA, PIM, WLSE</td>
<td>NARS, Development partners, ALIs e.g. ODI 91077 (1,000 ha)</td>
<td>Analytical tools for analyzing governance challenges and enabling / disabling factors</td>
<td>Governance challenges and enabling / disabling factors relevant to livelihood systems identified</td>
<td>Consultative identification of governance solutions with core stakeholders</td>
<td>Lobbying and consultation with government and non-governmental agencies</td>
<td>Governance approaches supporting livelihood systems innovation implemented by government and NGOs.</td>
<td>---</td>
<td></td>
</tr>
</tbody>
</table>
## FLAGSHIP 7: POST-HARVEST VALUE & OUTPUT MARKETS

### Country: NIGERIA

<table>
<thead>
<tr>
<th>OT</th>
<th>Sub-IDOs</th>
<th>Outputs; Outcomes</th>
<th>FP links</th>
<th>CG Centers</th>
<th>Partners</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
</tr>
</thead>
<tbody>
<tr>
<td>N.7.1.1</td>
<td>1.2.2, 1.3.3, B.1.2, C.1.1</td>
<td>5 technologies developed and made available to small scale processors</td>
<td>FS1</td>
<td>NARS, NGOs, Extension</td>
<td></td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N.7.1.2</td>
<td>1.2.2, 1.3.3, B.1.2, C.1.1</td>
<td>100 extension officers, NARS, NGOs trained</td>
<td>FS5, FS2</td>
<td>IITA, ICRISAT, ICRAF</td>
<td>NARS, NGOs, Extension</td>
<td>20</td>
<td>50</td>
<td>80</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N.7.1.3</td>
<td>1.2.2, 1.3.3, B.1.2, C.1.1</td>
<td>At least 1000 small scale processor adopt new technologies</td>
<td></td>
<td></td>
<td></td>
<td>200</td>
<td>500</td>
<td>700</td>
<td>1000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N.7.2.1</td>
<td>C.1.1</td>
<td>50000 farmers made aware of various technologies</td>
<td></td>
<td></td>
<td></td>
<td>2000</td>
<td>4000</td>
<td>45000</td>
<td>50000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N.7.2.2</td>
<td>1.3.2, 1.3.3, B.1.2, 1.4.1, C.1.1</td>
<td>At least 20 fabricators trained on new technologies for post harvest</td>
<td>FS5, FS2</td>
<td>IITA, ICRISAT, ICRAF</td>
<td>NARS, NGOs, Extension</td>
<td>5</td>
<td>15</td>
<td>17</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N.7.2.3</td>
<td>1.3.2, 1.3.3, B.1.2, 1.4.1, C.1.1</td>
<td>Post harvest losses reduced by 10%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N.7.2.4</td>
<td>1.3.2, 1.3.3, B.1.2, 1.4.1, C.1.1</td>
<td>2000 farmers adopt new technologies to reduce post harvest</td>
<td></td>
<td></td>
<td></td>
<td>500</td>
<td>1000</td>
<td>1500</td>
<td>2000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N.7.3.1</td>
<td>2.1.1, 2.1.2, 2.1.3, 1.3.1, 1.3.2</td>
<td>At least 4 new food products developed and made available</td>
<td>FS1, FS5</td>
<td>IITA, ICRISAT, ICRAF</td>
<td>NARS, NGOs, Extension</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N.7.3.2</td>
<td>2.1.1, 2.1.2, 2.3.2</td>
<td>Four animal feed formulation introduced</td>
<td>FS1, FS5</td>
<td>IITA, ICRISAT, ICRAF</td>
<td>NARS, NGOs, Extension</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N.7.3.3</td>
<td>2.1.1, 2.1.2, 2.3.2, C.1.1</td>
<td>2000 women and young people trained on different food and feed combination</td>
<td>FS1, FS5</td>
<td>IITA, ICRISAT, ICRAF</td>
<td>NARS, NGOs, Extension</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>500</td>
<td>1500</td>
</tr>
<tr>
<td>N.7.4.1</td>
<td>D.1.1, C.1.1, 1.3.2, 1.3.3</td>
<td>Two marketing strategies adopted by different stakeholders</td>
<td>FS1, FS5</td>
<td>ICRAF, IITA, ICRISAT</td>
<td>Private sector, NGO, Extension</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N.7.4.2</td>
<td>1.1.1, 1.2.2, 1.3.1, 1.3.2</td>
<td>Number of farmers involved in markets increased by 20 percent</td>
<td></td>
<td></td>
<td></td>
<td>5%</td>
<td>10%</td>
<td>20%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N.7.4.3</td>
<td>1.1.1, 1.2.2, 1.3.1, 1.3.2</td>
<td>Income of farmers and small scale processors (especially women and the youth) increased by 15%</td>
<td>2%</td>
<td>5%</td>
<td>7%</td>
<td>12%</td>
<td>15%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N.7.4.4</td>
<td>2.1.2</td>
<td>Quantity of products sold increased by 20%</td>
<td>5%</td>
<td>8%</td>
<td>14%</td>
<td>17%</td>
<td>20%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N.7.5.1</td>
<td>1.1.1, 1.2.2, 1.3.1, 1.3.2, B.1.1</td>
<td>Number of women involved in marketing/processing increased by 30%</td>
<td>FS1</td>
<td>ICRISAT, ICRAF, IITA</td>
<td>FARA, private sector</td>
<td>5%</td>
<td>10%</td>
<td>13%</td>
<td>20%</td>
<td>30%</td>
<td></td>
</tr>
<tr>
<td>N.7.5.2</td>
<td>1.1.1, 1.2.2, 1.3.1, 1.3.2, B.1.1</td>
<td>5000 young people and women trained in business development skills</td>
<td></td>
<td></td>
<td></td>
<td>1000</td>
<td>1500</td>
<td>2000</td>
<td>4000</td>
<td>5000</td>
<td></td>
</tr>
<tr>
<td>N.7.6.1</td>
<td>1.1.1, 1.2.2, 1.3.1, 1.3.2, B.1.1</td>
<td>2000 women and youth entrepreneurs linked to various private sectors</td>
<td>FS2</td>
<td>ICRISAT, ICRAF, IITA</td>
<td>Private sector</td>
<td>500</td>
<td>800</td>
<td>1200</td>
<td>1800</td>
<td>2000</td>
<td></td>
</tr>
<tr>
<td>N.7.6.2</td>
<td>1.1.1, 1.2.2, 1.3.1, 1.3.2, B.1.1</td>
<td>1000 youth trained on business development skills</td>
<td></td>
<td></td>
<td></td>
<td>200</td>
<td>600</td>
<td>800</td>
<td>1000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Annex 14. CAPACITY DEVELOPMENT FOR DCLAS

DCLAS CAPACITY DEVELOPMENT

1. Background

CD is one of the key pathways that will drive impact for CRP-DCLAS and one of the key performance indicators for the program’s success: ensuring the transfer from research outputs to development outcomes.

CRP-DCLAS participating Centers have a long history of CD interventions that enhanced capacities of partners and national agricultural research systems, extension and farmers. In addition, CRP-DCLAS via the support of the capacity development component will have to ensure to open, integrate others key stakeholders involved within the agricultural sector.

With the CRP-DCLAS uniting and coordinating the efforts of the involved Centers, it will allow to focus CD interventions into a comprehensive, holistic, integrated and all-inclusive systems approach to CD ensuring that the interventions are demand-driven and at the same time support the achievement of CRP-DCLAS IDOs.

The CD DCLAS component adopts a comprehensive definition of capacity development that includes all efforts, interventions, activities, and interactions aiming at developing the capacity of female and male individuals, institutions, organizations and systems to enable them to perform certain tasks leading to achieving research and developmental goals.

In this respect, the definition of CD goes beyond the traditional trainings and workshops, it is the ability of individuals, organizations and the system to perform research and transform research knowledge into successful pro-poor innovation and so will be included activities such as:

- communications and media,
- mentoring, coaching, internships, degree and non-degree research,
- policy and process development,
- governance restructuring,
- partnership mediation,
- strategy development,
- fund raising,
- project management cycle
- monitoring and evaluation
2. Capacity Building in DCLAS

**Vision:** Main stakeholders, partners and teams will have in place human resources, institutions and systems capable of effectively working collaboratively as integrated systems while successfully carrying out their defined roles in CRP-DCLAS, leading to the achievement of IDOs in the targeted DCLAS regions.

**Mission:** To ensure the development and successful implementation of a strategic, holistic, inclusive, results-oriented, internationally competitive and sustainable approach to CD that is fully integrated into the CRP-DCLAS IDOs and impact pathways and that leads to the development of capacities of participating actors and innovation systems as a means to support them in effectively achieving the targeted development outcomes. CRP DCLAS CD team will have to ensure a greater emphasis on the uptake of research as part of a broader innovation system and signals the need for an integrated approach to capacity development. This involves a move towards more multi-stakeholders, inter disciplinary and client driven and ensuring that all actors involved in the value chain will be involved since the beginning and will endorse the decision taken at the level of the innovation system platform.

CD is one of the **key pathways** that drive impact for CRP-DCLAS and one of the **key performance indicators** for the program’s success especially within the framework of ensuring that agricultural research outputs will be transferred to the other stakeholders involved in the value chain: development outcomes.

CRP DCLAS will support Capacity development to improve performance within a wider system, rather than as an end in itself. Therefore, there is generally an underlying **theory of change** (stated or implicit) that presumes that capacity development components will strengthen certain actors and modify attitudes and practices, in turn changing the performance of a wider system. Consequently, **appropriate data should be monitored** to track each of the steps in this theory of change – capability gains, behavior changes, and performance improvements – with the emphasis placed more on the performance improvements, and the link of improved performance to higher-order results.

Capacity Development is a complex interplay between individual, organizational and institutional levels. The focus of CD therefore is on the **process rather than just on the acquisition of skills and knowledge** to perform a defined task.

**Lessons learned from previous CRP’s and bilateral projects** will have to be addressed in order to capitalize on the best practices implemented, the networks of partnerships developed, key individual actors involved and also will have to learn from failures and we will have to adopt new process that will avoid those failures.

**Five main goals of DCLAS CD**

A. Developing the capacities of core **individuals, organizations** and **systems**;
B. Maximizing impact and reach through **partnering** with international, regional and local organizations, private sector and civil society;
C. Increasing **communication skills** : Getting to be known by our actions and results;
D. **Ensuring sustainability** of CD efforts through innovative resource mobilization;
E. A **continuum assessing processes** using Performance Gaps Analysis, Needs Assessment – Implementation assessment – Impact assessment throughout a common monitoring and evaluation processes and tools: Development of Capacity Snapshot using the following modus vivendi: no activities without identifying the needs, no activities without records, no records without analysis, no analysis without learning, no learning without action.
3. Framework for Capacity Development interventions at various levels:

4. Capacity Development Interventions in DCLAS

The range of capacity development interventions will be applied to the whole system engaged in delivering successful innovation and so the range of potential interventions needs to include those that are appropriate to public, private, community sector organizations and not just limited to traditional research institutes. It has to be noted that the interventions will need to be adapted to the specific specificities of each region involved within the CRP DCLAS. In some of the regions targeted the lack of competence can be on human resources (lacking qualified technicians or scientists but could also be lacking of mindset agricultural oriented concerned civil servants, NGO’s staff or private sector staff either at the local/regional or national administration) and/or on policies and regulations and/or on insufficient investment in facilities and infrastructure.

Research outputs within an innovation system are broader than purely technical and encompass methodological, policy, process and institutional outputs. The innovation system brings the users and the suppliers of knowledge together from outset which is the only way to ensure that innovation takes place. Research therefore remains important but is one element within the system.

4.1. Innovation System Platform (ISP)

ISP a rationale tool for mapping the national system, identifying stakeholders and their institutional relationships, assessing their capacities and identifying gaps and weaknesses for creating, adapting, packaging, trading, disseminating and using knowledge. The Innovation System platform should be the place to define and agree on the challenges, the modalities of interventions, ensuring the communication flow amongst all stakeholders, developing strategies. Innovation system platform should be led by well-trained international staff used to research and development projects management (specific ToR will have to be developed) and they should ensure that key local actor(s) will be supported and mentored in order to ensure continuity.

Developing the overall capacity of the agricultural innovation system with its various actors, incentives, norms, and processes focuses not only on the competencies needed to achieve technical results but also on what it takes to build more effective and dynamic relationships among multiple actors. CRP DCLAS Cap Dev team will be working throughout two main channels.
4.1.1. Operation Innovation System Platforms:

- Based on performance gaps results – target capacity development activities will be developed in order to ensure that the transfer of science knowledge will be ensured.
- **Definition**: Platforms that are set up at the grassroots level to respond to target commodity or system of production need for specific market.
- **Main partners**: CG Scientists/NARS/Extension staff/Hosting Farmers/Universities/ARI’s
- **Modalities of interventions**: Mentoring programs, Scholarships, On the job trainings, Train the trainers trainings, Study tours and modalities will have to be defined through Need Assessment with targeted stakeholders
- **Role of Cap Dev Team**: ensuring the smooth implementation of the activities by the concerned colleagues and quality insurance (for example: giving support to the activities to be conducted, evaluating the activities conducted, ensuring quality reporting, communicating on the activities implemented and scaling out.
- **Objectives**: Ensuring that local human resources will have the necessary skills/competencies to apply research on the ground and get results that will be communicated to other stakeholders via the Development channel see below.
- **Scope of intervention**: at Individuals, Organizations and Institutions levels
- **Governance model**: Establishment of Specific Innovation System Platform at the level of the research locations.

4.1.2. Strategic Innovation Channel:

Facilitating and coordinating with local stakeholders the establishment of Innovation System Platform.

- **Definition**: Platforms that are set up at higher level of governance and management hierarchies with a broader geographic coverage.
- **Main partners**: Cap Dev team/NARS/Extension staff/Farmers community/Private sector/NGO’s/Donors agency/Policy decision makers/Universities/Newspapers and TV at the local/regional and national level.
- **Modalities of interventions**: Mentoring programs, policy studies, fundraising, project management cycle, monitoring and evaluation, needs and impact assessments
- **Role of Cap Dev team**: Identifying the keys actors to be involved and their specific competencies within the value chain, setting up the Innovation platform system, gaps and specific needs, mentoring, coordinating with local identified and trained actor(s), implementing key activities commonly agreed on (importance of ownership) by the members of the platform. Capacity development also depends on the client’s skills, commitment, resources, and opportunity costs around processes of reflection, prioritization, absorption of new skills or knowledge, and putting new priorities, skills and knowledge into practice.
- **Objective**: the first objective of the members involved in the Innovation System Platform is to ensure that the key research questions addressed within the flagships are responding to the needs of the different actors and secondly of the main role of the platform will be to ensure that research results/outputs will be transferred to all the stakeholders
- **Scope of Cap dev intervention**: Individuals, Organizations and Institutions
- **Governance model**: Establishment of Innovation System Platform at the national level.

4.2. Capacity Development Intervention Modalities to at various level

<table>
<thead>
<tr>
<th>Modalities</th>
<th>Inputs</th>
<th>Outputs</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Cross cutting Modalities to be applied at Individual, organizational and institutional levels</td>
<td>Needs assessments, strategy design and implementation assessments</td>
<td>Situation analysis at different levels of interventions planned</td>
<td>Reports articulating capacity status and needs at individual, institutional and organizational levels</td>
</tr>
</tbody>
</table>
### Partnering Capacity
- Partners identifications and formal involvement and so from design phase, evidence of new partnering initiatives in project design and implementation, contribution of Cap Dev team to the partnership and communication strategies, involvement of private sectors
- Key Trained CRP and Center staffs to engage in partnerships; Evidence of appropriate partnerships
- Number of key trained staff; Number of new partnerships developed

### Monitoring and Evaluation
- Building on the system established on CRP DS to capture lessons learned on Cap Dev
- Detailed reporting online – tracking informations and ensuring quality reporting
- Number of reporting downloaded
  - Number of data collected and consulted
  - Number of Monitoring and Evaluation follow up implemented

#### b. Modalities of intervention at the individual levels
(Such as internships, mentoring program, scholarships/fellowships, group courses, farmers school, fields days, on the job trainings.)
Tool to be used: Building on online tool developed within CRP DS to map all activities implemented within CRP DCLAS and referring to the 9 CGIAR CapDev elements

<table>
<thead>
<tr>
<th>Design and delivery of innovation learning materials and approaches</th>
<th>Documenting learning materials developed distributed and shared across partners and stakeholders</th>
<th>Repositories of learning materials developed; Use of learning materials by number of downloads, google analytics, etc.; Development of an online platform for online training courses</th>
<th>Number of data collected and consulted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of learning materials; type of learning methods and approached designed to target groups; set of materials adapted to different audiences; link with communication and gender team, stakeholders involvement in the development of learning materials</td>
<td>Type of training: PhD, MSc, Fellowships, Internships, Mentoring, group courses</td>
<td>Alumni program established Alumni engaged in transferring knowledge and also becoming themselves mentored Publication records by former trainees Communication of research outputs amongst Alumni program</td>
<td>Number of conducted follow-up activities made by targeted actors to the local communities</td>
</tr>
</tbody>
</table>

#### c. Modalities of intervention at the organizational levels

<table>
<thead>
<tr>
<th>Developing future research leaders through fellowships, mentoring programs, internships, group courses, ...</th>
<th>Resource mobilization and partnerships; gender and youth balance; balance between well-resourced and lesser resource organizations; establishment of clear and transparent criteria of selections</th>
<th>Type of training: PhD, MSc, Fellowships, Internships, Mentoring, group courses</th>
<th>Alumni program established Alumni engaged in transferring knowledge and also becoming themselves mentored Publication records by former trainees Communication of research outputs amongst Alumni program</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of trained by type and gender Position of trainees within national or local system after having been trained</td>
<td>Number of data collected and consulted</td>
<td>Number of conducted follow-up activities made by targeted actors to the local communities</td>
<td></td>
</tr>
</tbody>
</table>
Organizational development

Specific training to Center/CRP Staff to carry out non research activities critical for up scaling research outputs; Specific interventions explicitly designed to enhance partner research activities
Specific interventions designed to enhance partners to take use research outputs for scaling up development interventions;
Resource mobilization strategy developed and potential opportunities identified;

Specific training to Center/CRP Staff to carry out non research activities critical for up scaling research outputs; Specific interventions explicitly designed to enhance partner research activities
Specific interventions designed to enhance partners to take use research outputs for scaling up development interventions;
Resource mobilization strategy developed and potential opportunities identified;

Quantity of core researchers and innovation coordinators personnel with adequate knowledge, skills and motivation within different organizations trained;
Number of initiatives developed between donor-partner, partner-partner, partner-stakeholders;
Number of initiatives implemented on resource mobilization having reached their goal;

Number of conducted follow-up activities made by core researchers and innovation coordinators to the local communities;
Number of new projects submitted;
Number of new projects granted;

<table>
<thead>
<tr>
<th>d. Modalities of intervention at the Institutional levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Institutional strengthening</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>d. Modalities of intervention at the Institutional levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Institutional strengthening</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>d. Modalities of intervention at the Institutional levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Institutional strengthening</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>d. Modalities of intervention at the Institutional levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Institutional strengthening</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

| Number of conducted follow-up activities made by core researchers and innovation coordinators to the local communities; |
| Number of new projects submitted; |
| Number of new projects granted; |
Annex 15. CVs OF THE DCLAS FLAGSHIP WRITING TEAM

Please note that although the three component CRPs, Dryland Cereals, Dryland Systems and Grain Legumes had planning meetings including all partner representatives in March and April, 2015, towards preparation for the second phase, partners are not represented in the writing team for the preproposal. This will be done for the full proposal.

DCLAS Flagship 1: Priority Setting & Impact Acceleration
Technical competency Flagship writing team members

1. Ingrid Öborn  ICRAF, leader of the flagship writing team
2. Arega Alene  IITA
3. Lieven Claessens  ICRISAT
4. Amos Gyau  ICRAF (also Flagship 7)
5. Dave Harris  ICRAF
6. Karl Hughes  ICRAF
7. Jan de Leeuw  ICRAF
8. Eike Luedeling  ICRAF
9. Kizito Mazvimavi  ICRISAT
10. Kai Mausch  ICRISAT
11. Constance Neely  ICRAF
12. Esther Njuguna-Mungai  ICRISAT
13. Alastair Orr  ICRISAT
14. Karin Reinprecht  ICARDA
15. Fergus Sinclair  ICRAF
16. Tor-Gunnar Vagen  ICRAF
17. Mark van Wijk  ILRI
18. Yigezu Yigezu  ICARDA
**Profile**


Management Committee, part-time Executive Office (cross-CRP, integrated systems conference & book, back-stopping area based flagships, etc.), ICRAF Focal point (foresight, sustainable intensification & diversification)

**Program Director** Future Agriculture–Livestock, Crops and Land Use Program 2009-2012 (incl. leading the foresight, global and regional scenario development, and research priority setting through an interdisciplinary multi-stakeholder process)

**Deputy Program Director** (2012) & leading the proposal development (2011): Mistra Biotech - Biotechnology for sustainable and competitive agri-food systems (combining novel breeding tools with ethical aspects, consumer perception and behaviour, sustainability indicators and systems analysis)

**Highest Qualification/s (up to 2)**

- MSc in Agriculture, major agronomy and soil science 1984, Swedish University of Agricultural Sciences (SLU), Uppsala, Sweden
- PhD in Soil Science 1994, Swedish University of Agricultural Sciences (SLU), Uppsala, Sweden

**Recent Positions held (2-3)**

- Senior Research Fellow, World Agroforestry Centre (ICRAF), Nairobi, Kenya, 2012-ongoing
- Professor of Agricultural Cropping Systems, Dept. Crop Production Ecology, SLU, 2009-ongoing, on leave for the CGIAR, still part-time SLU
- Visiting Professor, Scotland’s Rural Collage, Edinburgh, UK, 2012-

**Relevant and recent Publications (Max 5)**

**Publications** [see www.slu.se/ingridoborn](http://www.slu.se/ingridoborn)


AREGA D. ALENE
IITA, Malawi. Email: A.ALENE@CGIAR.ORG

<table>
<thead>
<tr>
<th>Profile</th>
<th>Arega Alene’s research interests include R&amp;D impact evaluation, productivity analysis, agricultural policy, and international development. He has published over 40 scientific articles in the leading agricultural and development economics journals. His research interests include R&amp;D impact evaluation, productivity analysis, agricultural policy, and international development.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highest Qualification(s) (up to 2)</td>
<td>• Dr. Alene holds a PhD in Agricultural Economics from the University of Pretoria, South Africa</td>
</tr>
<tr>
<td>Recent Positions held (2-3)</td>
<td>Arega Alene is an agricultural economist with IITA and leads research programs on impact evaluation and strategic analysis of R&amp;D investments and priorities. Arega coordinates IITA’s work on the CGIAR research program on policies, institutions, and markets.</td>
</tr>
</tbody>
</table>
### Profile

Lieven Claessens has extensive experience with spatial analysis, integrated assessment and modelling of soil – landscape - land use systems. He is a co-developer of the LAPSUS modeling framework, a collection of spatially explicit landscape process simulation models (water erosion by runoff, tillage erosion and landsliding). LAPSUS has been explicitly linked to methodologies addressing ecological processes and land use change to assess interactions and feedback mechanisms between landscape, land use and landcover. In addition he has experience with crop growth simulation models, food security and yield gap assessment (www.yieldgap.org), digital soil mapping, integrated assessments of agricultural systems and land use change modeling (www.cluemodel.nl) with a focus on smallholder farming systems in Sub-Saharan Africa. Current research is focusing on interactions and feedback mechanisms between bio-physical and socio-economic processes from household to watershed and regional scale levels in the context of food security and sustainable intensification under climate change (www.agmip.org, www).

### Highest Qualification/s (up to 2)

<table>
<thead>
<tr>
<th>Year</th>
<th>Qualification</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2012-2015: Regional Coordinator for SSA and SA in the 'Global Yield Gap and Water Productivity Atlas' project (funded by BMGF). Principal Investigators: Prof K. Cassman, Prof M. van Ittersum. <a href="http://www.yieldgap.org">www.yieldgap.org</a></td>
</tr>
<tr>
<td></td>
<td>From 2011: Contact point at ICRISAT for the CGIAR Research Program 'Climate Change, Agriculture and Food Security (CCAFS)'. <a href="http://www.ccafs.cgiar.org">www.ccafs.cgiar.org</a></td>
</tr>
</tbody>
</table>

### Relevant and recent Publications (Max 5)

**DAVE HARRIS**  
World Agroforestry Center, UN Avenue, P.O. Box 30677-00100 Nairobi, Kenya. d.harris@cgiar.org

### Profile (around 50 words)

Current research focuses on the prospects for Sustainable Intensification of smallholder agriculture and trying to understand why rural households adopt/don’t adopt/dis-adopt improved agricultural technologies.

### Highest Qualification/s (up to 2)

#### Recent Positions held (2-3)

- **2015-present.** Senior Advisor to the Research Methods Group at ICRAF and a Senior Research Fellow at Bangor University, UK.  
- **2014.** Consultant for ICRAF and Senior Research Fellow at Bangor University, UK. Member of Science Advisory Group, Africa RISING.  

### Relevant and recent Publications (Max 5)

### KARL ALAN HUGHES

United Nations Avenue, Gigiri, P.O. Box 30677 - 00100, Nairobi, Kenya  
T: +254 20 722 4393 (direct) | M: +254 700 299 171 | E: k.hughes@cgiar.org

<table>
<thead>
<tr>
<th>Profile (around 50 words)</th>
<th>• Impact evaluation and monitoring and evaluation (M&amp;E) specialist with over 17 years of experience in the international development sector, 14 years of which has been based in Africa and Asia.</th>
</tr>
</thead>
</table>
| Highest Qualification/s (up to 2) | • Doctor of Philosophy (Impact Evaluation), London School of Hygiene and Tropical Medicine, UK (2012)  
• Masters of Environmental Studies, York University, Canada (1998) |
| Recent Positions held (2-3) | • Head of Monitoring, Evaluation and Impact Assessment, World Agroforestry Centre (ICRAF), Nairobi, Kenya (10/2014 to present)  
• Senior Evaluation Specialist, Independent Evaluation Department, Asian Development Bank (ADB), Manila, Philippines (04/2013 to 10/2014)  
• Program Effectiveness Team Leader, Oxfam GB, Oxford, UK (02/2010 to 03/2013)  
• Program Manager (Chief of Party & M&E Lead), Christian Aid, Regional Office, Nairobi (05/2005 to 01/2010)  
• Technical Advisor, Canadian Physicians for Aid and Relief (CPAR), Malawi Country Office (01/2002 to 05/2005)  
• Project Officer, World University Service of Canada (WUSC), Malawi and Zimbabwe Field Offices (01/2000 to 01/2002)  
• Registered Consultant, Canadian International Development Agency (CIDA)  
• Ottawa, Canada (07/1999 to 01/2000)  
• Aga Khan Fellow, Centre for Community Economics and Development Consultants Society (CECODECON) Rajasthan, India (07/1998 to 06/1999) |
| Highest Qualification/s (up to 2) | • Groningen University, Biology, PhD, 1992  
| | • Groningen University, Biology, MSc, 1980  
| | • Free University Amsterdam, Biology, BSc, 1976  
| Recent Positions held (2-3) | 2012 – present  
| | Senior Researcher Drylands Agroforestry  
| | 2009 – 2012  
| | Project Leader Pastoral Systems Research. ILRI, Nairobi, Kenya  
| | 1996 - 2009  
| | Associate Professor Environmental Science. ITC, Enschede, the Netherlands.  
| | 2002 – 2004  
| | Visiting Professor Fac. Env. Engineering, Tsinghua University, Beijing, PR China.  
| | 2003 – 2006  
| | Guest Professor School Resources and Env. Sciences, Wuhan University, PR China.  
| | 1992 – 1996  
| | Assistant Professor Vegetation Science. ITC, Enschede, the Netherlands.  
| | 1988 – 1992  
| | Senior Scientist. CEMO-NIOO, KNAW, Yerseke, The Netherlands.  
| | 1983 – 1988  
| | University Lecturer. Institut Superior Polytechnique, University of Ouagadougou.  

---

**JAN DE LEEUW**  
ICRAF, Nairobi, Kenya, +254-737223157, E-mail:j.leeuw@cgiar.org
**EIKE LUEDELING**  
World Agroforestry Centre, c/o Centre for Development Research, Walter-Flex-Str. 3, 53113 Bonn, Germany.  
e.luedeling@cgiar.org

<table>
<thead>
<tr>
<th>Profile (around 50 words)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Interdisciplinary scientist working on adapting business decision analysis approaches for application in development contexts.</td>
</tr>
<tr>
<td>• Research on methods to consider risk and uncertainty in producing decision models through participatory approaches.</td>
</tr>
<tr>
<td>• Holistic, transdisciplinary impact projection, spatial targeting and prioritization among intervention options.</td>
</tr>
<tr>
<td>• Broad experience in climate change research and modelling.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Highest Qualification/s (up to 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• PhD (2007) in Agricultural Science, University of Kassel, Germany</td>
</tr>
<tr>
<td>• MSc (2005) in International Agricultural Development, University of California, Davis, USA</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Recent Positions held (2-3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Since 2013 Senior Decision Analyst, ICRAF, lead decision analysis work</td>
</tr>
<tr>
<td>• 2010-2013 Climate Change Scientist, ICRAF, research on climate change impacts, adaptation and mitigation</td>
</tr>
<tr>
<td>• 2008-2009 Postdoctoral Scholar, University of California Davis, research on climate change issues, project coordination</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Relevant and recent Publications (Max 5)</th>
</tr>
</thead>
</table>
# Kizito MAZVIMAVI
ICRISAT Zimbabwe, Matopos Research Station, P O Box 776, Bulawayo, Zimbabwe

**Email:** K.Mazvimavi@cgiar.org

## Highest Qualification/s (up to 2)
- Ph.D. Development Studies, 2004, University of Wisconsin-Madison, USA.
- M.A. Agricultural and Applied Economics, 2002, University of Wisconsin-Madison, USA.
- M.Phil. Agricultural Economics, 1997, University of Zimbabwe, Harare, Zimbabwe.

## Recent Positions held (2-3)
- **Country Representative and Head - Impact Assessment, ICRISAT Zimbabwe.** *(Since May 2014)*
- **Head - Impact Assessment,** ICRISAT Patancheru, India. *(May 2012 – April 2014).*
- **Scientist - Agricultural Economics** ICRISAT Bulawayo, Zimbabwe. *(July 2008 – April 2012).*
- **Regional Scientist.** ICRISAT Bulawayo, Zimbabwe. *(January - June 2008).*
- **Post-Doctoral Fellow.** ICRISAT Bulawayo, Zimbabwe. *(December 2004 – December 2007).*
- **Project Assistant:** Land Tenure Center, University of Wisconsin-Madison USA. *(Sept. 1999-2003)*
- **Research Fellow Development Technology Center, University of Zimbabwe** *(Jan. 1994–98).*
- **Research Associate: SADC/ICRISAT** *(December 1990 - December 1993)*

## Relevant and recent Publications (Max 5)

Dr. Kai Mausch has been working intensively on the adoption and impact of modern legume varieties in East- and Southern Africa. He has worked very successful in multidisciplinary teams in various projects and programs both within and beyond ICRISAT. He has been spearheading the inclusion of modern ICT technologies in ICRISAT’s research methods and facilitated their spread across all African locations and to other CGIAR centers. Furthermore, the use of new information dissemination channels and technologies to both the research community and the end-user was led by Dr. Mausch. He has built a strong network with experts in the field an in-depth understanding of the agricultural system in the region.

Dr. rer. pol. (Doctor of Economics), Leibniz University of Hannover, Hannover, Germany, 2010  
Diplom Ökonom (Diplom economist), Leibniz University of Hannover, Hannover, Germany, 2007

**Recent Positions held**  
Since 01 / 2013, Scientist (Economics), ICRISAT, Nairobi, Kenya  
o  
Implementation of the economics components of legume related projects in Eastern and Southern Africa;  
o  
Topics range from adoption, dissemination, impact evaluation, value chain analysis, to targeting of project interventions;  
o  
One of the key focuses is the analysis and improvement of the delivery of ICRISAT’s products to the final beneficiary, in the context of changing markets and rural household characteristics  
12/2009 – 12/2012, Associate Professional Officer (Economics), ICRISAT, Lilongwe, Malawi  
o  
Analysis of the global dissemination and spillover effects from ICRISAT’s past and present research to support priority setting and quantify resulting impacts

**Relevant and recent Publications**  
## Profile (around 50 words)

Cross-Sectoral Integration Landscape Approaches and Participatory Program Management, Research, Development and Advocacy for Sustainable Agriculture and Natural Resource Management; Convening and Integration of Research, Practice and Policy; Concept Development, Design, Management and Facilitation of Multi-Stakeholder Dialogues for Coalition Building, Decision Making, Advocacy and Implementation for Sustainable Development Impacts; Internationally Certified Facilitator and Educator, Trained in Negotiation Skills, Conflict Resolution.

## Highest Qualification/s (up to 2)

- Ph.D. in Agroecology 1990

## Recent Positions held (2-3)

- SENIOR ADVISOR to the Director General on Research-Practice-Policy Integration 2010 – Present World Agroforestry Centre, Nairobi (Kenya). Strategic facilitation of integrated landscape and livelihoods approaches for enhanced resilience, with emphasis on integration of research, practice and policy. Developer and coordinator of the Stakeholder Approach to Risk Informed and Evidence Based Decision Making (SHARED), aimed at increased impact of decisions through a participatory and inclusive approaches.
- SENIOR CONSULTANT 2002 – Present. Food and Agriculture Organization (FAO), Rome (Italy), and to IFAD, the CGIAR, USDA-ARS, OECD, World Bank, CSU
- Intergovernmental Organizations (FAO, IFAD, World Bank, OECD, UNCCD, UNICEF), International Research (CGIAR) and Academic (University of Georgia, Auburn University, Texas A&M and Colorado State University), INGOs (Heifer International, Holistic Management International/Savory Institute, World Vision), Government (USDA, ARS and USDA), MEAs (UN CBD, CCD, FCCC, CSD), Private Enterprise (Kalani Coffee and Tea, Hallowed Hawk Farms)

## Relevant and recent Publications (Max 5)

<table>
<thead>
<tr>
<th><strong>Profile (around 50 words)</strong></th>
<th>Esther is an social scientist who with 15 years experience working with smallholders farmers in Arid and Semi Arid regions. She has worked with the National Research programme in Kenya, leading and supporting projects aimed at enhancing adoption, resilience building and improving livelihoods in the drylands.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Highest Qualification/s (up to 2)</strong></td>
<td>1. PhD, Agricultural Economics, University of Nairobi, Kenya; (2005 – 2009) 2. MSc, Wageningen University and Research Centre, The Netherlands, (1999 to 2001), MSc. in Agricultural Economics, Development Economics option</td>
</tr>
</tbody>
</table>
| **Recent Positions held (2-3)** | SCIENTIST, GENDER RESEARCH, CRP On Grain Legumes  
Period, position and Organization with a brief nature of responsibilities being handled  
- 2014 to date: Scientist, Gender Research for CGIAR Program on Grain Legumes, coordinating gender research in the CRP. She operates from the International Centre for Research in Semi Arid Tropics (ICRISAT) in Nairobi  
- 2011 to 2014, Research Associate, KARI McGill Food Security Research Project; project coordination, co-leading gender mainstreaming participatory market systems development component of the project  
- 2010-2011, Monitoring and Evaluation and Gender Support Specialist, Kenya Arid and Semi Arid Lands (KASAL) projects, |
**ALASTAIR ORR**  
ICRISAT Eastern and Southern Africa, PO Box 3963 Nairobi, Kenya  
Email: A.Orr@cgiar.org

**Profile (around 50 words)**  
Dr Orr has 30 years’ experience of research on smallholder agriculture both in Asia and sub-Saharan Africa. His experience covers farming systems research, integrated pest management, and smallholder value chains. Since 2010 he has led ICRISAT’s socio-economic research on dryland cereals in Eastern and Southern Africa, focusing on access to markets, value chains and social inclusion, with field research in Kenya, Ethiopia, Tanzania, Uganda, and Malawi.

**Highest Qualification/s (up to 2)**  
- PhD (Economics)  
- MSc (Agricultural Economics)

**Recent Positions held (2-3)**  
Period, position and Organization with a brief nature of responsibilities being handled  
- Principal Scientist (Economics) and Assistant Director, ESA, 2010-present.  
- Principal Scientist, Natural Resources Institute, United Kingdom, 2002-2009  

**Relevant and recent Publications (Max 5)**  
## Profile (around 50 words)
Karin has been working over the past 20 years as an independent consultant in economic development, including finance and organization development. She elaborated numerous strategies, gender audits, gender analyses, gender (baseline) studies, several gender & youth tools, and consulted on gender mainstreaming and integrating gender in indicators, budget, and organizational processes.

## Highest Qualification/s (up to 2)
- Dr. Phil. (University of Vienna)
- International Economics and Politics (post-graduate diploma from Vienna Diplomatic Academy)

## Recent Positions held (2-3)
- Gender Program Coordinator of CRP Dryland Systems (framework consulting contract) – started January 2015
- Independent consultant since 1993: [www.karinreinprecht.com](http://www.karinreinprecht.com) (project list and CV)
- Coordinator of private sector development in Vienna leading a team of five who were based in Africa and Latin America (framework consulting contract with the Austrian Development Cooperation in the Foreign Ministry), 1995 - 2004

## Relevant and recent Publications (Max 5)
1. A viable structure for the Alfred Nzo District Municipality, systems diagnosis jointly with Hans Stoisser, published in 2009 by SWISSCONTACT and ECOTEC
3. Organisational self-check for business service and finance providers for inclusive and effective service provision (FAMOS Check tool), ILO (published in 2007) (studies not published, but accepted by contracting organisation:
4. Evaluation of a women entrepreneurship development project in Kenya, Tanzania and Uganda reaching out to 90% rural and 40% young women testing participatory systems research methods (ILO, 2015)
5. Study on extent and type of financing for women-owned SME in Sub-Saharan Africa (African Development Bank, 2012))
FERGUS SINCLAIR
World Agroforestry Centre (ICRAF), Box 30677, Nairobi, Kenya. Email: f.sinclair@cgiar.org.
Link to Google Scholar profile:
https://scholar.google.co.th/citations?user=8IKLALEAAAAJ&hl=en

Profile
Best known for his pioneering work on agroforestry science, policy and practice the acquisition and use of local knowledge in agricultural development and the measurement and modelling of complex social-ecological systems (http://www.cifor.org/realizingfutures/_ref/home/index.htm), Fergus has spent the last 30 years applying systems theory to the practical realities of agricultural and forest development in Africa, Asia and Latin America. He started as a training officer with the Ministry of Agricultural and Water Development in Zambia, cutting his teeth on the development and roll out of farming systems methods. Most recently he has been engaged in developing negotiation support tools (Polyscape) for exploring trade-offs and synergies amongst impacts of land use change on ecosystem services (Pagella and Sinclair, 2014; Jackson et al 2013) and conceiving and implementing a new ‘research in development’ paradigm that applies systems research methods at the scale of impact (see Coe et al., 2014).

Highest Qualification/s (up to 2)
- 1995 PhD. Modelling Agroforestry. Department of Forestry and Natural Resources. University of Edinburgh, UK
- 1983 BSc (Hons) First Class, Agriculture (Tropical Agricultural Systems), University of Reading, UK

Recent Positions held (2-3)
- Systems Science Domain Leader, World Agroforestry Centre (75% as a research collaboration with Bangor University, UK where also on the faculty in the School of the Environment, Natural Resources and Geography 25%); Visiting Professor, Center for Agricultural Research and Higher Education, Turrialba, Costa Rica.
- Before joining ICRAF was Director of Research at the School of Agricultural and Forest Sciences, University of Wales, Bangor, UK and Director of their Centre for Advanced Research in International Agricultural Development.

Relevant and recent Publications (Max 5)
<table>
<thead>
<tr>
<th><strong>Profile (around 50 words)</strong></th>
<th>Senior Scientist and head of the GeoScience Lab, World Agroforestry Centre March 2012 – present. Develop and lead the GeoScience Lab, a new global science unit at the World Agroforestry Centre. Countries worked in: Madagascar, Kenya, Tanzania, Ethiopia, Mali, Zimbabwe, Mozambique, South Africa, Malawi, Uganda, India, China, Nicaragua, Honduras, Norway, Sweden</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Highest Qualification/s (up to 2)</strong></td>
<td>• PhD candidate Norwegian University of Life Sciences and Ohio State University, OH, USA January 2001 - November 2004</td>
</tr>
</tbody>
</table>
| **Recent Positions held (2-3)** | • Senior Scientist, World Agroforestry Centre, July 2011 - February 2012  
• International Scientist, World Agroforestry Centre, July 2007 - June 2011  
• Postdoctoral fellow, World Agroforestry Centre, July 2005 - June 2007  
• Principal scientist, Norwegian Institute for Agricultural and Environmental Research, December 2004 - June 2005 |
MARINUS THEODORUS (MARK) VAN WIJK  
ILRI (International Livestock Research Institute), Livestock Systems and the Environment, Nairobi, Kenya, currently based at CATIE, Costa Rica.  
Email: Mark.vanwijk@wur.nl; m.vanwijk@cgiar.org

<table>
<thead>
<tr>
<th>Profile (around 50 words)</th>
<th>Van Wijk’s research focuses on interactions between (agro)ecosystems and the environment combining empirical and theoretical analyses in agronomic and ecological work. His agronomy research focuses on smallholder farming systems, currently mainly in sub-Saharan Africa but also systems in Latin America have been analysed. Recent projects include the coordination of CCAFS funded work on farm household modelling and analyses, the EU funded AfricaNUANCES project, IDRC Climate Change and the CGIAR System-wide Livestock Program. In a project on land use issues in sub-Saharan Africa the competing claims on land were analysed in a multi-objective optimization approach, exploring the trade-offs between the interests of different stakeholders. His ecological research focuses on relations between plant traits and ecosystem functioning, the latter expressed in terms of carbon exchange and water use.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highest Qualification/s (up to 2)</td>
<td></td>
</tr>
</tbody>
</table>
| Recent Positions held (2-3) | • Mark van Wijk is senior scientist at ILRI since November 2011  
• Almost 10 years as assistant professor at Wageningen University. In the past 15 years he has obtained a wide experience in both fundamental and applied research in agro-ecosystems across the world. |
| Relevant and recent Publications (Max 5) | 6. **M.T. van Wijk**. 2014. From global economic modelling to household level analyses of food security and sustainability: how big is the gap and can we bridge it? *Food Policy* 49, 378 - 388.  
YIGEZU ATNAFE YIGEZU  
ICARDA, Email: Y.Yigezu@cgiar.org

**Profile (around 50 words)**

Yigezu’s areas of interest include: International development, production and natural resource economics, policy analysis, technology adoption and impact assessment, and bio-economic modeling of production systems. He has skills in Mathematical programming and Econometrics. Yigezu has a total 19 years work experience out of which 7 are with CG centres.

<table>
<thead>
<tr>
<th>Highest Qualification/s (up to 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• PhD (2009) in Agricultural Economics from Purdue University, USA.</td>
</tr>
<tr>
<td>• MSc (2005) in Agricultural Economics from Purdue University, USA.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Recent Positions held (2-3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Period, position and Organization with a brief nature of responsibilities being handled</td>
</tr>
<tr>
<td>• Agricultural Economist – ICARDA (July 2011-date)</td>
</tr>
<tr>
<td>• Postdoctoral scientist – ICARDA (June 2010-June 2011)</td>
</tr>
<tr>
<td>• Senior research assistant – ILRI (June 2009 – August 2001)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Relevant and recent Publications (Max 5)</th>
</tr>
</thead>
</table>
DCLAS FLAGSHIP 2: PRE-BREEDING, TRAIT DISCOVERY & DEVELOPMENT  
DCLAS FLAGSHIP 3: VARIETY AND HYBRID DEVELOPMENT  

**ANNEX B: TECHNICAL COMPETENCY FLAGSHIP WRITING TEAM MEMBERS**

<table>
<thead>
<tr>
<th>Name</th>
<th>Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>T H Noel</td>
<td></td>
</tr>
<tr>
<td>STEPHEN BEEBE</td>
<td>CIAT</td>
</tr>
<tr>
<td>SHIV KUMAR AGRAWAL</td>
<td>ICARDA</td>
</tr>
<tr>
<td>MELAKU GEDIL</td>
<td>IITA</td>
</tr>
<tr>
<td>STEFANIA GRANDO</td>
<td>ICRISAT</td>
</tr>
<tr>
<td>BOUKAR OUSMANE</td>
<td>IITA</td>
</tr>
<tr>
<td>RAJEEV KUMAR VARSHNEY</td>
<td>ICRISAT</td>
</tr>
<tr>
<td>RAMESH PAL SINGH VERMA</td>
<td>ICARDA</td>
</tr>
</tbody>
</table>
# T. H. NOEL ELLIS, (UNAFFILIATED),
n.ellis@cgiar.org

## Profile
My research interests have been in the comparative genetics and genomics of legumes. At an organisational level I am interested in the application of basic research for applied aims, especially those that relate to the UN Strategic Development Goals.

<table>
<thead>
<tr>
<th>Highest Qualification/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>• B.Sc., Ph.D.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Recent Positions held (2-3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 2013 – 2015 Director, CGIAR Research Program on Grain Legumes</td>
</tr>
<tr>
<td>• 2011 – 2013 Professor of Crop Genetics, IBERS</td>
</tr>
</tbody>
</table>

## Relevant and recent Publications (Max 5)


| **Profile** | • Practical field-based breeder interacting with scientists working in modern methods and in plant physiology, having developed more than 40 varieties for both biotic and abiotic stress, and more recently for high iron, for 15 countries in both Africa and Latin America.  
• More than 15 years’ experience in project management |
| **Highest Qualification/s (up to 2)** | B.Sc., Horticulture, 1974, Iowa State University; M.Sc., Ph.D., Plant breeding, University of Wisconsin, 1976, 1978. Career developed in Latin America at CIAT headquarters and including 4 years in Guatemala in a regional bean improvement project. Since 1995, with wider involvement in Eastern-southern Africa. Last decade has focused on tolerance to abiotic stresses (drought, low P, aluminum toxicity, and more recently heat stress). Pioneered biofortification of common bean for high iron, the first such research in a legume. |
| **Recent Positions held (2-3)** | • **2002 to present:** Project manager, Bean Improvement Project, CIAT. Responsible for fund-raising and reporting for a team of 14 scientists.  
• **1998 to present:** Bean breeder in Bean Improvement Project, CIAT. Responsible for breeding of small seeded common bean of the Mesoamerican gene pool, for resistance to biotic (viral, bacterial and fungal pathogens) and abiotic (drought and soil constraints), and for high iron and zinc concentration. |
SHIV KUMAR AGRAWAL, PhD  
Food Legumes Coordinator  
International Center for Agricultural Research in the Dry Areas (ICARDA)  
Morocco Platform, PO box 6299, Rabat, Morocco  
Email: Sk.agrawal@cgiar.org, Shiv_iipr@email.com  
Phone: +212-537682909 (landline); +212-679769599 (mobile)  
Fax: +212-537675496; Skype: shiv_kumar_agrawal

<table>
<thead>
<tr>
<th>Profile</th>
<th>26 years of experience in agricultural research for development in Asia and Africa. Skilled Plant breeder with proven record in genetic enhancement of food legume crops with 36 varieties with wide adaptation in 11 countries. 322 publications including 122 research articles, 7 books, 7 bulletins, 2 manuals, 2 germplasm catalogues and 55 book chapters.</th>
</tr>
</thead>
</table>
| Highest Qualification/s (up to 2) | - PhD in Plant Breeding & Genetics in 1989  
- MSc in Plant Breeding & Genetics in 1986 |
| Recent Positions held (2-3) | 2009 – Present, Food Legume Coordinator, ICARDA, Genetic enhancement of Lentil and grass pea and coordinating food legumes program of the Centre and Centre Focal Point for CRP-Grain Legumes and CRP-Agro. for Nutrition & Health  
2006-2009, Head, Crop Improvement Division, IIPR-ICAR, Breeding legume crops and providing technical guidance on project implementation in the division  
1999-2006, Senior Legume breeder, IIPR-ICAR, Breeding food legume crops using conventional and molecular approaches |
| Relevant and recent Publications (Max 5) | (Total Impact factor 58.32 and Research Gate Score 26.95)  
**MELAKU GEDIL**  
Head, IITA Bioscience Center  
Molecular Geneticist/Molecular Breeder  
International Institute of Tropical Agriculture  
PMB 5320, Oyo Road, Ibadan, Nigeria  
phone: +1-201 633 6094 ext 2703  
email: m.gedil@cgiar.org

**Profile**
- Background in plant breeding, statistical genetics, molecular biology, and bioinformatics
- Research focus on applying an efficient and effective molecular breeding program for biotic and abiotic stresses as well as quality traits.
- Experience in marker-assisted recurrent selection (MARS), genome-wide association study (GWAS), genome selection, linkage/QTL mapping, comparative genomics and bioinformatics.
- Training and mentoring of graduate students and technicians

**Highest Qualification/s (up to 2)**
- PhD in Crop Science, Oregon State University, Corvallis, Oregon, 1999
- MSc in Biotechnology, bioinformatics, Georgetown University, Washington DC, 2005

**Recent Positions held (2-3)**
- 2010 unto present, Head of Bioscience Center, IITA, Nigeria
- 2007 unto present, Molecular geneticist/breeder, development of markers for disease resistance, quality traits in various crops including cowpea and soybean.

**Relevant and recent Publications (Max 5)**
**BOUKAR OUSMANE**  
International Institute of Tropical Agriculture (IITA), Kano Station  
Sabo Bakin Zuwo Road PMB 3112 Kano, Nigeria  
Phone: +234- 8060522204; o.boukar@cgiar.org

**Profile**

Provides essential oversight and leadership for IITA’s cowpea improvement program. He uses creative approaches in the exploitation of genomic data for germplasm enhancement which result in improved cowpea varieties meeting farmers and consumers preferences across SSA. He is active in capacity building of NARS and established strong partnerships with Advanced Research Institutions, for upstream research.

**Highest Qualification/s (up to 2)**

- Ph.D., Plant Breeding & Genetics, Purdue University, West Lafayette, (IN, US) 2002
- M.S., Plant Breeding & Genetics, Purdue University, West Lafayette, (IN, US) 1998

**Recent Positions held (2-3)**

- April 2007 – Present: Cowpea breeder/geneticist, IITA Kano and Ibadan Stations, Nigeria, Cowpea genetic improvement targeting international community especially SSA.
- Jan 2003 - March 2007: Regional Scientific Coordinator, Maroua Regional Research Center, Agricultural Research Institute for Development, Maroua, Cameroon, Scientific coordination of research activities in Maroua center.

**Relevant and recent Publications (Max 5)**

DR RAJEEV KUMAR VARSHNEY,
Research Program Director – Grain Legumes & Director, Center of Excellence in Genomics & Winthrop
Research Professor, School of Plant Biology, The University of Western Australia.
International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru-502 324, Telangana,
India

Contacts: Tel: 040 30713305, Fax: 040 30713074; email: r.k.varshney@cgiar.org

Profile (around 50 words) Rajeev Varshney is a Research Program Director, Grain Legumes & Director - Center of Excellence in Genomics as well as Winthrop Research Professor at The University of Western Australia. He is internationally recognized for his contribution in genome sequencing of pigeonpea, chickpea, peanut, pearl millet, sesame, mungbean and azuki bean and development of molecular breeding products in chickpea and peanut.

Highest Qualification /s (up to 2)
- Ph.D. (2001) CCS University, Meerut, India, Agricultural Botany (Molecular Biology)
- M.Sc. (1995) AMU, Aligarh, India, Botany (Genetics, Plant Breeding & Molecular Biology)

Recent Positions held (2-3)
• August 2013 to date, Research Program Director – Grain Legumes, International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru, India.
  Responsibilities: Strategic direction and supervision of research activities on different disciplines i.e. Breeding, Physiology, Pathology, Entomology, Genetic Engineering, Genebank related to Legume improvement
• January 2012 – to date, Director, Center of Excellence in Genomics (CEG), International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru, India.
  Responsibilities: Genomics assisted breeding for semi-arid crops
• August 2007 – September 2013, Leader, SubProgramme 2, Generation Challenge Programme (GCP), hosted by CIMMYT, Mexico (50% position)
  Responsibilities: Comparative genomics and gene discovery

Relevant and recent Publications (Max 5)
**Profile**
Currently working as Coordinator for barley program at ICARDA for CRP Dryland Cereals since May 2013. More than 29 years’ experience in national and international research in South and West Asia, Latin America, North and east Africa. Developed more than 20 barley varieties in various countries. Lead national and international projects on genetic enhancement of barley. More than 75 publications in refereed journals, book chapters, proceedings and official bulletins, contributed to germplasm evaluation and registration.

**Qualification**
- PhD in plant breeding with minor in plant pathology.

**Positions held (2-3)**
1985- May-2013  Pr. Scientist/ Sr. Scientist/ Scientist (Plant breeding-Barley), ICAR, India
2013 onwards  Barley Breeder/Pr. Scientist, ICARDA, Morocco

**Relevant and recent Publications (Max 5)**
DCLAS FLAGSHIP 4: SEED SYSTEMS AND INPUT SERVICES
TECHNICAL COMPETENCY FLAGSHIP WRITING TEAM MEMBERS

1. ALPHA YAYA KAMARA IITA
2. ZEWDIE BISHAW ICARDA
3. TAMÒ MANUELE IITA
4. JEAN CLAUDE RUBYOGO CIAT
5. RONNIE Vernooy Bioversity International
### Profile
Alpha Yaya Kamara, is a **Systems Agronomist** and a **Principal Scientist** working at the International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria. Dr Kamara has extensive experience spanning over 20 years, conducting research to improve cereal-legume production systems with publication of over 70 journal articles in peer-review journals. He has managed several research projects and continues to be PI for several other projects implemented by IITA. He is currently the Head of IITA Research Station in northern Nigeria, focal person for WLE CRP and the principal investigator for the seed systems component of TLIII project at IITA.

### Highest Qualification/s (up to 2)
- PhD Agronomy and Natural Resource Management, University of Kassel, Germany (1998)
- M.Sc Agronomy, Christian Albrecht University of Kiel, Germany (1993)

### Recent Positions held (2-3)
- **January 2000-Present**: Post-Doc, Associate, Senior and Principal Scientist, as Systems Agronomist in diverse projects and core research activities, International Institute of Tropical Agriculture
- **September 15, 2011- To-date**: Station Head, IITA Station, Kano, Nigeria
- **March 2007- To-date**: Taskforce leader, Sudan Savanna taskforce of the Kano-Katsina Maradi-PLS of the sub-Saharan African Challenge program, and Principal investigator and leader, cowpea and soybean seed systems component of the Tropical Legume project

### Relevant and recent Publications (Max 5)
**ZEWDIE BISHAW**  
Head of Seed Section and International Nurseries, ICARRDA, P.O. Box 5689, Addis Ababa, Ethiopia; Mobile: +251-911-225674; E-mail: z.bishaw@cgiar.org

### Profile
- A trained seed technologist (MSc & PhD) with broad managerial and technical knowledge and experience of 35 years in seed sector development and responsible for strengthening the national seed systems targeting both the formal (public and private seed sector) and informal (farmer-based) seed sectors in CWANA, South Asia and SSA;

### Highest Qualification/s (up to 2)
- PhD in Production Ecology and Sustainable Conservation (Seed Technology), Wageningen University, the Netherlands
- MSc in Seed Technology, Edinburgh University, Scotland, UK

### Recent Positions held (2-3)
- **Head, Seed Section and International Nurseries, ICARDA (since April 2006)**
  - Provide strategic leadership and technical support in setting strategies and priorities and designing innovative research approaches on technological, institutional and policy issues for seed sector development at national, regional and global levels that increase availability and access to new crop varieties and seeds by farming communities to ensure food security;
  - Working experience with government officials, NARS, seed program leaders, public & private seed companies, farmers’ groups, NGOs, regional/international research centers, international agricultural & seed sector development organizations, global & regional seed associations.
  - Mobilized resources for research and seed sector development in partnership with national, regional and international organizations in excess of USD 25 million in recent year

- **Seed Systems Specialist & Coordinator, Seed Unit, ICARDA (1999-April 2006)**
  - Manage WANA Regional Seed Network of 19 countries and 11 international organizations and provide technical support and capacity development in the seed sector

### Relevant and recent Publications (Max 5)
- Alemu, D and Z. Bishaw. 2015. Commercial behaviours of small-holder farmers in wheat seed and its implication for seed demand assessment in Ethiopia. *Development in Practice (accepted).*
**TAMÒ MANUELE**  
International Institute of Tropical Agriculture (IITA)  
Entomologist and Country Representative, IITA-Benin, Cotonou, Benin  
office +229 64 18 15 15, mobile +229 95 96 13 06, e-mail: m.tamo@cgiar.org

### Profile

**Expertise:** Development and deployment of biological control and bio-pesticides against insect pests in cereal-legume cropping systems, insect ecology, simulation models for crop-pest interactions, development of ICT tools for disseminating biological control and bio-pesticide information with low-literacy farmers. He has been the principal investigator of several special projects totaling in excess of US$ 11 Million. He has supervised 17 PhD students (5 on-going) and 15 MSc/DEA students (2 on-going). He has published over 150 written reports, including 93 peer reviewed journal articles and book chapters. He can easily communicate in English, French, German and Italian (mother tongue).

### Highest Qualification/s (up to 2)

- PhD: Swiss Federal Institute of Technology, Zurich (ETHZ), Institute of Plant Sciences, - 1991  
- MSc: Swiss Federal Institute of Technology, Zurich (ETHZ), Faculty of Agriculture - 1986

### Recent Positions held (2-3)

- **Current:** Insect Ecologist, IITA Country Representative for Benin, active research portfolio of several projects targeting the ecology and control of insect pests in cereal-legume systems, cotton, cashew and Jatropha.  
- In 2012 he was elected IITA focal point for the CGIAR Program on Grain Legumes, and in 2013 he was appointed coordinator of Product Line 5 (insect-smart legume systems) and RMC member of the same CRP.  
- In 2001 he was nominated Leader of the Plant Health Management Program of IITA, position he held until the programmatic research structure of IITA was modified in 2006.

### Relevant and recent Publications (Max 5)

JEAN CLAUDE RUBYOGO
Seed Systems and Agricultural Technology Transfer Specialist
International Center for Tropical Agriculture (CIAT) – Pan African Bean Research Alliance (PABRA), P.O.Box 2704 Arusha Tanzania.
Email: j.c.rubyogo@cgiar.org, Telephone: +255-688-030-600

Profile
Jean Claude Rubyogo is a seed system and Agricultural technology transfer specialist with 30 years in agricultural Research for Development. He has published 40 publications in areas of seed systems, agricultural technologies, value chains and crop improvement. He has led several CIAT/PABRA seed systems/reaching end users components contributing significantly to the establishment and management of an efficient private and public partnership (see http://www.pabra-africa.org).

Highest Qualification/s (up to 2)
MSc in Crop Improvement, University of Nottingham, UK (2005)

Recent Positions held (2-3)
**January 2004-Present:** Seed systems and Technology Transfer Specialist in various CIAT-PABRA supported projects including leadership of TLIII –seed systems (BMGF), Bean Seed Systems (Syngenta Foundation for Sustainable Agriculture) and Bean Seed Systems – AGRA/SSTP.


**July 1997- November 2003:** Agricultural and Natural Resource Management Coordinator – Germany Technical Cooperation

Relevant and recent Publications (Max 5)
1. **Rubyogo, J.C.,** Magreta R.; Dymon Kambewa, R. Chirwa, E. Mazuma and M. Andrews () Using subsidized seed to catalyze demand-driven bean seed systems in Malawi accepted by Development in Practice Journal
2. Teshale Assefa, Jixiang Wu, Stephen Beebe, Idupulapati M Rao; Daniele Marcomin and **Rubyogo Jean Claude** (2014) Improving adaptation to drought stress in small red common bean phenotypic differences and predicted genotypic effects on grain yield, yield components and harvest index : Euphytica

DCLAS PRE-PROPOSAL
### Profile

- Program and project design and management in the fields of Rural and Agricultural Development, Natural Resources Management, and Conservation of Biodiversity
- Leadership in Participatory Action Research including Participatory Plant Breeding
- Design and execution of (Participatory) Monitoring and Evaluation plans for programs and projects
- Development of innovative curriculum and capacity building strategies including monitoring and evaluation Strategies

### Highest Qualification/s (up to 2)

- Ph.D. Sociology of rural development, the Agricultural University of Wageningen, Wageningen, the Netherlands, 1992. Thesis: Starting all over again: making and remaking a living on the Atlantic Coast of Nicaragua.

### Recent Positions held (2-3)

- 2011 – present: Genetic Resources Policy Specialist, Policies, Institutions and Monitoring Group, Bioversity International, Rome, Italy. Leading and managing various projects on genetic resources policies, adaptation to climate change and community seed banks.
- 1992-2010: Senior program specialist, Agriculture and Natural Resource Management, the International Development Research Centre (IDRC), Ottawa, Canada. Supporting researchers from developing countries in the design, development, implementation, monitoring and evaluation of applied research projects.
- 2005 – 2010: Adjunct professor, College of Humanities and Development (COHD), China Agricultural University, Beijing, China. Co-facilitating MSc and PhD level course on Community-based natural resources management; Co-designing and managing fellowship program.

### Relevant and recent Publications (Max 5)

DCLAS FLAGSHIP 5: INTEGRATED LAND, WATER & CROP MANAGEMENT

Technical competency Flagship writing team members

1. THEIB Y. OWEIS  ICARDA
2. JENNIE BARRON  IWMI
3. BOGACHAN BENLI  ICARDA
4. STEPHEN K. BOAHEN  IITA
5. BIJU GEORGE  ICARDA
6. Devra I. Jarvis  Bioversity
7. ALPHA KAMARA  IITA
8. FRED KANAMPIU  IITA
9. MOHAMMED KARROU  ICARDA
10. IAN W MAKIN  IWMI
11. SHALANDER KUMAR  ICRISAT
12. TAMÒ MANUELE  IITA
13. EVERISTO MAPEDZA  IWMI
14. VINAY NANGIA  ICARDA
15. ALAN NICOL  IWMI
16. CLAUDIO ZUCCA  ICARDA
THEIB Y. OWEIS,
Director, Integrated Water & Land Management Program, ICARDA
15 Khalid Abu Dalbouh St., Abdoon Eshamali, Amman 11183, Jordan
Tel Office: +96265903120 ext. 223, Mobile: +962796076075; E-mail: t.oweis@cgiar.org

<table>
<thead>
<tr>
<th>Profile</th>
<th>Agricultural water and land management specialist with over 30 years of experience in international research, development and training especially in water scarce dry environments. Author of over 200 refereed journal publications, books/book chapters and conference proceedings in the areas of water use efficiency/productivity, supplemental irrigation, water harvesting, deficit irrigation, salinity and the management of scarce water resources. Contributed to the advocacy and promotion of the concepts of water productivity and SLM practices in agriculture.</th>
</tr>
</thead>
</table>
| Highest Qualification/s                                               | 1. PhD in Agricultural and Irrigation Engineering from Utah State University (USU), Logan, Utah, USA 1983.  
2. MSc in soil and irrigation from USU, Logan, Utah, USA 1980. |
| Recent Positions held                                                 | 1. ICARDA, since 2006, director of the IWLM Program. Earlier and since 1991, at ICARDA in several capacities as scientist, principal scientist, research team leader and research manager.  
3. Dar Al Handasah Consultants (Shair and Partners), 1973-1977. Field irrigation engineer. Supervising the construction of a large scale spate irrigation project in Abyan delta of then South Yemen. |
JENNIE BARRON  
Theme Leader for Sustainable Agricultural Water Management Institute, P.O. Box 2075, Colombo. Tel: +94 11 2880000 / Mobile: +94 776 631362/ Email: j.barron@cgiar.org

Profile

I am currently the Research Theme Leader of “Sustainable Agricultural Water Management” at International Water Management Institute (IWMI). I develop, lead and coordinate research for development activities in IMWI and WLE in Volta-Niger, Nile basin and south and SE Asia. The research activities aim to deliver evidence-based knowledge for local and national policy and investments for sustainable outscaling and intensification through agricultural water management for human wellbeing. Over the last 20 years, I have worked with agricultural, water and land management related research, policy, capacity strengthening and development in sub-Saharan Africa and Asia. I have secured substantial funding for R4D activities in international competition, and served as reviewer to e.g., UK, Swedish, Norwegian and French research councils. My research has informed various international and national research and policy processes, meetings and documents incl., the CGIAR and ISPC, the Swedish Environmental Advisory Council, FAO, UNCCD and UNEP on agricultural development, benefits for economies and livelihoods, and sustainability. In 2014 I was nominated to ACADEMIA-NET (www.academia-net.org/), a network of excellent female researchers from all disciplines. I have 35 peer scientific papers and book chapters, and more than 25 peer research reports with more than 1200 citations since 2010 (Google Scholar: https://scholar.google.com/citations?user=8u07d1UAAAAJ&hl=en )

Highest Qualification/s (up to 2)

<table>
<thead>
<tr>
<th>Year</th>
<th>Qualification</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>Ph.D. in Natural Resource Management, Dep. of Systems Ecology, Stockholm University, Sweden</td>
</tr>
<tr>
<td>1994</td>
<td>M.Sc. in Agric. Sci. (soil sci hydology) Swedish University of Agricultural Sciences, Uppsala, Sweden</td>
</tr>
</tbody>
</table>

Recent Positions held (2-3)

<table>
<thead>
<tr>
<th>Year</th>
<th>Position Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009 to 2015</td>
<td>Senior Research Associate/ Theme leader (90%) SEI, University of York, UK; Senior Researcher (10%) Stockholm Resilience Centre, Stockholm University, Sweden</td>
</tr>
<tr>
<td>2006 to 2008</td>
<td>Research associate, SEI, University of York, UK</td>
</tr>
<tr>
<td>2004 to 2006</td>
<td>Project Officer Stockholm University, Project Researcher Stockholm Environment Institute (SEI), Stockholm</td>
</tr>
</tbody>
</table>

Relevant and recent Publications (Max 5)


Barron, J. 2014. Water resources and functions for agro-ecological systems at the landscape scale (Ch.7). In ’Water Resilience for Human Prosperity’ Eds Rockstrom et al, Cambridge University Press


Dr. Benli was a post-doc specialist between the years 2004-2007 at ICARDA HQ, and responsible for the Water Benchmarks project regional coordination, in some 10 countries of Middle East and North Africa. Following his tenure at ICARDA, he has joined at United Nations Development Programme, and have managed a Regional Water Partnership program called "Every Drop Matters" between the years 2007-2010 in the countries of East Europe and CIS region. Between the years 2010 and 2014, Dr. Benli has managed the Global Program of "Inclusive Community Based Water Management and Adaptation to Climate Change Project for Catalyzing Achievement of the MDGs" in East Europe, CIS, Middle East and Asia Pacific Countries at UNDP. Dr. Benli has wide experience in Agricultural Water Management, Water & Sanitation and Adaptation to Climate Change in some 30 developing countries.

**Profile**

<table>
<thead>
<tr>
<th>Highest Qualification/s (up to 2)</th>
<th>2002 PhD. Water Management and Irrigation – Ankara University</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1997 DSKU, Agricultural Economics and Models – Institute Agronomies de Pays Méditerranéen, Montpellier.-</td>
</tr>
</tbody>
</table>

**Recent Positions held (2-3)**

- October 2010 - September 2014, Global Programme Manager, UNDP Water Governance Programme. Developed and implemented, a private sector joint initiative, in some 26 countries of East Europe, CIS, Middle East and Asia Pacific regions, targeting the achievement of MDG7 and Adaptation to Climate Change.
- March 2007 – October 2010, Regional Programme Manager, UNDP East Europe and CIS, Managed a regional programme, called every Drop Matters, active in 10 countries of East Europe, aiming the achievement of WASH MDGs.
- March 2004 – March 2007, ICARDA HQ. Regional Project Coordinator of Water Benchmarks in CWANA. Coordinated the Regional Water Benchmarks project and conducted research in water management and irrigation, in 10 countries of MENA.

**Relevant and recent Publications (Max 5)**


**Book/Book Chapters**

2. **La Rovere, R., Benli, B. And Cossee, O.,** 2014. A FRAMEWORK FOR A SYSTEMATIC ASSESSMENT OF INTERVENTIONS ON ACCESS TO WATER AND SANITATION: UNDP'S EVERY DROP MATTERS PROGRAMME. COPYRIGHT © 2014 BY UNITED NATIONS DEVELOPMENT PROGRAMME. NY.
<table>
<thead>
<tr>
<th><strong>Profile</strong></th>
<th>Biju George is an Irrigation and Water Management specialist at the International Centre for Agriculture Research in the Dry Areas (ICARDA), Cairo, Egypt. He is also a Senior Fellow at the Melbourne School of Engineering, the University of Melbourne. He has more than 15 years of experience in conducting research, developing research collaborations and teaching. His research interests include water resources systems, on-farm irrigation systems, hydrologic modelling, climate change impact assessment and water energy nexus. He has published more than 100 research publications in international and national journals and conferences in the fields of water allocation modelling, irrigation system management, water-energy nexus and hydrology.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Highest Qualification/s</strong></td>
<td>2003 Ph.D., Water Resources Management, Indian Institute of Technology. 1998 B Tech., Agricultural Engineering, Kerala Agricultural University, India</td>
</tr>
<tr>
<td><strong>Recent Positions held (2-3)</strong></td>
<td><strong>Period: Jul 2014 – present</strong>  <strong>Position:</strong> Irrigation and Water Management Specialist, ICARDA, Cairo, Egypt.  <strong>Responsibility:</strong> Coordinate and conduct research, research management, capacity building and proposal writing.  <strong>Period: Aug 2011 – Jun 2014</strong>  <strong>Position:</strong> Senior Research Fellow, Melbourne School of Engineering, The University of Melbourne  <strong>Responsibility:</strong> Coordinate and conduct research, project management, student supervision and teaching.</td>
</tr>
</tbody>
</table>
STEPHEN K. BOAHEN
International Institute of Tropical Agriculture (IITA), Av. Eduardo Mondlane 326, 2nd Floor 210, Nampula, Mozambique; Tel: +258 26216381; Cell: +258 823045286;
Email: s.boahen@cgiar.org

Profile (around 50 words)
Systems Agronomist with over 15 years of experience in research and development activities in agronomy, soil fertility management, plant stress physiology, seed systems and farmer participatory technology evaluation. He manages projects on developing improved crop management strategies for legume-based cropping systems and seed systems. He has published more than 20 journal articles and over 15 papers in conference proceedings.

Highest Qualification(s) (up to 2)
- Ph.D. Plant Science, University of Saskatchewan, Saskatoon, Canada.
- MSc Agronomy, University of Helsinki, Finland

Recent Positions held (2-3)
- Systems Agronomist, IITA, 2007-present; responsible for the development of improved crop management strategies and seed systems to enhance smallholder farmer access to improved seeds
- Research Agronomist, Delta Research and Extension Center, Mississippi State University, Stoneville, MS; 2003-2007: Soybean agronomy and production systems

Relevant and recent Publications (Max 5)
- Kumar, P. L., Sharma, K., Boahen, S.K., Tefera, H., Tamo, M. 2011. First report of soybean witches'-broom disease caused by Group 16SrII phytoplasma in soybean in Malawi and Mozambique. Plant Disease 95(4) 492 – 495
### Profile (around 50 words)

Specialists in the assessment and management of crop genetic diversity in production systems with over 25 years of experience in international research, development and training. She leads cross-disciplinary scientific work on developing practices that use local crop genetic diversity to maintain and improve productivity and resilience in the production systems of smallholder farmers. She has published extensively in journal articles, book chapters, and reviews with national partners in English, French, Russian, Chinese, Arabic and Spanish worldwide.

### Highest Qualification/s

4. MSc in Forest Resource Management, University of WA. USA 1985
5. BA with Honors, Anthropology, University of Calif. Berkeley, USA 1981

### Recent Positions held

4. Bioversity International, since 1996, currently principal scientist since 2012, earlier in several capacities as senior scientist and research team leader.
5. Agropolis Foundation Science Council, since 2011, Chair science 2013.
6. Washington State University, Pullman, WA USA, Adjunct faculty since 2007, Crop and Soil Sciences Department.
7. Institut Agronomique et Vétérinaire Hassan II, Rabat, Morocco. Adjunct Professor since 2012.

### Relevant and recent Publications

7. Coomes, OT; McGuire, S; Garine, E; Caillon, S.; McKey, D; Demeulenaere, E., Jarvis, D; Aistara, G; Barnaud, A; Clouvel, P; Emperaire, L; Louafi, S; Martin, P; Massol, F; Pautasso, M; Violon, C; Wencelius, J, 2015. Farmer seed networks make a limited contribution to agriculture? Four common misconceptions. Food Policy (accepted 27 July 2015)
# Alpha Yaya Kamara

Systems Agronomist and Head of Station, International Institute of Tropical Agriculture (IITA), Sabo Barkin Zuwo Road, Kano, Nigeria. Email: A.Kamara@cgiar.org. Telephone: +234-803-647-9031

## Profile (around 50 words)
Alpha Yaya Kamara, is a **Systems Agronomist** and a **Principal Scientist** working at the International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria. Dr Kamara has extensive experience spanning over 20 years, conducting research to improve cereal-legume production systems with publication of over 70 journal articles in peer-review journals. He has managed several research projects and continues to be PI for several other projects implemented by IITA. He is currently the Head of IITA Research Station in northern Nigeria, focal person for WLE CRP and the principal investigator for the seed systems component of TLIII project at IITA.

## Highest Qualification/s (up to 2)
- PhD Agronomy and Natural Resource Management, University of Kassel, Germany (1998)
- M.Sc Agronomy, Christian Albrecht University of Kiel, Germany (1993)

## Recent Positions held (2-3)
**January 2000-Present:** Post-Doc, Associate, Senior and Principal Scientist, as Systems Agronomist in diverse projects and core research activities, International Institute of Tropical Agriculture  
**September 15, 2011- To-date:** Station Head, IITA Station, Kano, Nigeria  
**March 2007- To-date:** Taskforce leader, Sudan Savanna taskforce of the Kano-Katsina Maradi-PLS of the sub-Saharan African Challenge program, and Principal investigator and leader, cowpea and soybean seed systems component of the Tropical Legume project

## Relevant and recent Publications (Max 5)
7. **Kamara A. Y.**. Friday Ekeleme, Jibrin M. Jibrin, Gbessay Tarawali, and Ibrahim Tofa (2014), Assessment of level, extent and factors influencing *Striga* infestation of cereals and cowpea in a Sudan Savanna ecology of northern Nigeria. Agriculture, Ecosystems and Environment 188 (111–121  
FRED KANAMPIU,  
IITA IITA-icipe office, Nairobi, Kenya; P.O Box 30772-00100, Nairobi, Kenya; Tel: +254-20-8632937 cell: +254-722-1548; Email: F.Kanampiu@cgiar.org

<table>
<thead>
<tr>
<th>Profile</th>
<th>Has 25 years of extensive experience in conducting agricultural research, technology development, and dissemination in cereal-legumes-livestock systems in East and Southern Africa, local and regional project implementation, coordination and management, including publishing, with public and international organizations. Have sound knowledge of international agriculture and development issues with first-hand experience in areas of agriculture, food security, capacity strengthening, and donor relations.</th>
</tr>
</thead>
</table>
| Highest Qualification/s (up to 2) | • PhD – Soil Science  
• MSc Agronomy |
| Recent Positions held (2-3) | **2014 to date:** Project Coordinator, IITA. N2Africa Project: Putting nitrogen fixation to work for smallholder farmers in Africa through enhancing the yield of legumes (common bean, cowpea, groundnut and soybean) and expanding the farm area cropped with legumes to improve incomes and food and nutrition security.  
**2007-2014:** Senior Scientist and project leader of several projects, CIMMYT: Leading and monitoring the implementation of projects executed across countries, maintaining liaison with key partners and stakeholders in the public and private sectors, and ensuring implementation of project-related agreements. |
| Relevant and recent Publications (Max 5) | PAPERS:  
MOHAMMED KARROU  
Integrated Water and Land Management Program, ICARDA  
ICARDA, P.O. Box / 6299, Rabat-Instituts, Morocco  
Phone #: +212 5 37 68 29 09  
m.karrou@cgiar.org

<table>
<thead>
<tr>
<th>Profile</th>
</tr>
</thead>
<tbody>
<tr>
<td>The areas of research are Agronomy and Crop physiology. The research areas are related to the strategies of improvement of water productivity through crop management and breeding in rainfed agro-systems, the response of crops to irrigation water, Mechanisms of tolerance of crops to abiotic stresses (drought and heat) and water relations, Fertilizers management and Genotypic variation of nutrients use efficiency. On-farm water harvesting.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Highest Qualification/s (up to 2)</th>
</tr>
</thead>
</table>
| • PhD in Agronomy/Crop Physiology from the University of Lincoln, Nebraska, USA  
• MS in Agronomy from the University of Missouri Columbia, USA. |

<table>
<thead>
<tr>
<th>Recent Positions held (2-3)</th>
</tr>
</thead>
</table>
| • 2007 till now: Water and Drought management specialist, ICARDA: 1) Conduction of research on drought management and crop water productivity; 2) Coordination of regional projects on Integrated Water and land management; 3) Coordinator of the CRP Dryland Systems in the Action Site of Meknes-Sais, Morocco  
• 1995-2006: Head of Agronomy Department and scientist at INRA-Morocco.  
The areas of at INRA-Morocco were, Agronomy and Crop production systems, Stress physiology and Water management in Agriculture. |

<table>
<thead>
<tr>
<th>Relevant and recent Publications (Max 5)</th>
</tr>
</thead>
</table>
SHALANDER KUMAR  
South Asia Coordinator CRP Dryland Systems & Scientist Dryland Systems, ICRISAT – International Crops Research Institute for the Semi-Arid Tropics, Patancheru, Hyderabad, Telangana 502324, India,  
Email: k.shalander@cgiar.org I Skype: Shalander.kumar  
Phone: +91 40 30713045 I Mobile: +91 9989807521

| Profile | He has worked across NARS (in India) and CGIAR. His major experience has been on dryland farming systems characterization and implementing systems approach, assessing farm level rainwater harvesting, conservation agriculture, NRM & institutional options for management of agriculture and common property resources, climate change impacts, functioning and interactions in the livestock production systems, innovation systems (innovation platforms) and partnership development. He has experience of working in South Asia, Ethiopia and The Netherlands. He has more than 40 peer reviewed journal papers and more 75 conference and other publications to his credit. |
| Highest Qualifications |  
- Ph.D.  
- M.Sc./ B.Sc. in Agriculture |
| Recent Positions held (2-3) |  
**2013– 2015:** South Asia Coordinator CRP Dryland System & Scientist Dryland Systems, ICRISAT: Implemented systems research (system tools) for resilience building and sustainable intensification in dry areas; institutional options for management of agriculture and common property resources and coordinating Innovation platforms and partnerships  
**2011-2013:** Head, Division of Transfer of Extension, CAZRI, Jodhpur: Innovation systems, climate adaptation, impact assessment  
**2010-2011:** Principal scientist & National Coordinator, National Initiative on Climate Resilient Agriculture (NICRA), CRIDA, Hyderabad: Coordinated and implemented NICRA across 100 districts in India. Analysing dryland farming systems, rainwater harvesting, conservation agriculture, climate change impacts and extension systems. |
| Relevant and recent Publications (Max 5) |  
1. Haileslassie Amare, P Craufurd, Thiagarajah Ramilan, **Kumar, Shalander**, et al. 2015. Empirical evaluation of sustainability of divergent farms in the dryland farming systems of India. Ecological Indicators (Accepted)  
2. **Kumar, Shalander**, Haileslassie Amare, Thiagarajah Ramilan; Wani Suhas P. 2014. Assessing different farming systems for enhancing farm income and resilience in extreme dry region of India. www.ageconsearch.umn.edu/bitstream/165846/2/Kumar%20CP.pdf  
IAN W MAKIN,
Theme Leader - Revitalizing Irrigation, International Water Management Institute, P.O. Box 2075, Colombo. Tel: +94 11 2880000/Email: i.makin@cgiar.org

Profile
Ian is an Agricultural Engineer, with over 35 years of experience in irrigation systems operations and performance management in research, consultancy and development finance positions. Over his career Ian has expanded his management skills from specialized research project management to a competency in multi-disciplinary, multi-cultural management and organizational development through a series of challenging appointments and personal training. At ADB Ian provided leadership to teams on water-related investments in resources management, river basin development and agricultural water management; and conducted research related to ADB operations including as lead author of the Asian Water Development Outlook 2013. As Regional Director and Principal Water Management Specialist, at IWMI SEA 2003-2005, Ian led a range of research and capacity building initiatives in South East and South Asia, including research studies to match irrigation system design and operations to achieve sustainable system performance. His research at IWMI 1996-2003, included the application of on-line systems to provide ready access to large data sets, including: (i) IWMI Water and Climate Atlas; (ii) Irrigation and Drainage System Benchmarking Software, and (iii) NARBO web application for performance benchmarking of River Basin Organizations. Also undertook research and consultancy assignments for World Bank, Asian Development Bank, UNCDF and UK Department for International Development (DfID). He has worked in Bangladesh, India, Indonesia, Malaysia, Pakistan, Thailand, Sri Lanka, Philippines, Mongolia, Viet Nam, Uzbekistan, China, Lao, Sudan, Rwanda, Botswana, Swaziland and Zambia and Zimbabwe. He has over 70 publications.

Highest Qualification/s (up to 2)
- 1980 MSc, Agricultural Engineering, National College of Agricultural Engineering, Silsoe, UK
- 1977 HNC, Civil Engineering, Oxford Polytechnic, Oxford, UK.

Recent Positions held (2-3)

Relevant and recent Publications (Max 5)
1. Lankford, B.A; Makin, I; Matthews, N; Noble, A; McCormick, P. G.; and Shah, T. (forthcoming) A framework to revitalise large-scale irrigation systems; a ‘theory of change’ approach – submitted to Water Alternatives
**TAMÒ MANUELE**  
International Institute of Tropical Agriculture (IITA)  
Entomologist and Country Representative, IITA-Benin, Cotonou, Benin  
office +229 64 18 15 15 mobile +229 95 96 13 06, e-mail: m.tamo@cgiar.org

**Profile**
- **Expertise:** Development and deployment of biological control and bio-pesticides against insect pests in cereal-legume cropping systems, insect ecology, simulation models for crop-pest interactions, development of ICT tools for disseminating biological control and bio-pesticide information with low-literacy farmers. He has been the principal investigator of several special projects totalling in excess of US$ 11 Million. He has supervised 17 PhD students (5 on-going) and 15 MSc/DEA students (2 on-going). He has published over 150 written reports, including 93 peer reviewed journal articles and book chapters. He can easily communicate in English, French, German and Italian (mother tongue).

<table>
<thead>
<tr>
<th>Highest Qualification/s (up to 2)</th>
</tr>
</thead>
</table>
| • PhD: Swiss Federal Institute of Technology, Zurich (ETHZ), Institute of Plant Sciences, - 1991  
• MSc: Swiss Federal Institute of Technology, Zurich (ETHZ), Faculty of Agriculture - 1986 |

**Recent Positions held (2-3)**
- Current: Insect Ecologist, IITA Country Representative for Benin, active research portfolio of several projects targeting the ecology and control of insect pests in cereal-legume systems, cotton, cashew and Jatropha.
- In 2012 he was elected IITA focal point for the CGIAR Program on Grain Legumes, and in 2013 he was appointed coordinator of Product Line 5 (insect-smart legume systems) and RMC member of the same CRP.---
- In 2001 he was nominated Leader of the Plant Health Management Program of IITA, position he held until the programmatic research structure of IITA was modified in 2006.

**Relevant and recent Publications (Max 5)**


EVERISTO MAPEDZA

Profile

Everisto is a Senior Social and Institutional Researcher who has an interest in engaging in applied social science research which leads to impact. This entails engagement in grounded field research which helps inform policy makers. Through the CPWF research on four irrigation schemes in Zimbabwe lessons of experience were drawn which have been used to provide input in the ongoing Irrigation Policy development in Zimbabwe. Also provided research leadership through projects such as the Challenge Program on Water and Food (CPWF). The leadership has entailed involvement from proposal development, research methodology development, data collection, analysis and report writing. Is also currently providing leadership of the Southern Africa component of the CRP1.3: Aquatic Agricultural Systems whose initial hub is the Barotse Flood Plain in Zambia. Is currently the Focal Point for CRP1.1. Dryland Systems Integrated Agricultural Production Systems for the Poor and Vulnerable in Dry Areas with IWMI research focussing on South Asia, Central Asia, West Africa, East and Southern Africa. Has published just over 20 peer reviewed journal and book chapters. Has served as a managing co-editor for a part-special issue on the commons which was published in the Water International Journal in 2014. Everisto has also reviewed manuscripts submitted for publication consideration in a number of journals as well as proposals submitted for funding.

Highest Qualification/s (up to 2)

<table>
<thead>
<tr>
<th>Year</th>
<th>Qualification</th>
<th>Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td>Ph.D.</td>
<td>Edinburgh University, Edinburgh, United Kingdom</td>
</tr>
<tr>
<td>1996</td>
<td>MSc. Rural and Urban Planning</td>
<td>University of Zimbabwe</td>
</tr>
</tbody>
</table>

Recent Positions held (2-3)

<table>
<thead>
<tr>
<th>Year</th>
<th>Position</th>
<th>Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014 - date</td>
<td>Senior Researcher, IWMI, Southern Africa office, Pretoria, South Africa</td>
<td></td>
</tr>
<tr>
<td>2003 - 2006</td>
<td>Alcoa Research Fellow, London School of Economics and Political Science, UK</td>
<td></td>
</tr>
</tbody>
</table>

Relevant and recent Publications (Max 5)

VINAY NANGIA
International Center for Agricultural Research in the Dry Areas (ICARDA), P.O. Box 950764, Amman, Jordan. Phone: +962-6-552-5750; +962-79-545-6033, Email: v.nangia@cgiar.org, Websites: www.icarda.org

Profile
An agricultural hydrologist at ICARDA and an adjunct faculty at Texas A&M University. He has served as a leader on research projects worth about USD 6 million, authored or co-authored 60 technical publications that include 25 refereed journal articles. He serves on the editorial boards of four professional society journals and has served as a research advisor/committee member to 5 M.S. and 6 Ph.D. students.

Highest Qualification
- Ph.D. (2005), Water Resources Science, University of Minnesota, USA
- M.S. (2001), Biosystems & Agricultural Engineering, University of Minnesota, USA

Recent Positions held
- Integrated Water, Land and Ecosystems Management Program, ICARDA, Amman, Jordan
  - Jul, 2011 – present: Senior Agricultural Hydrologist
  - Nov, 2011 – present: Capacity Development Coordinator
  - May, 2015 – present: Focal Point for CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS)
- Dept. Ecosystems Sci. and Mgmt., Texas A&M University, College Station, TX, USA
  - Mar, 2015 – present: Adjunct Faculty
- Agriculture and Agri-Food Canada, Ottawa, Ontario, Canada

Relevant and recent Publications
**ALAN NICOL**
Theme Leader - Governance, Gender and Poverty, International Water Management Institute, P.O. Box 2075, Colombo. Tel: +94 11 2880000 / Email: a.nicol@cgiar.org

<table>
<thead>
<tr>
<th>Profile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alan is a development professional with 20 years of experience in research, policy advice, consulting and programme development and management. He is a political scientist by training and his chosen area of focus is on water resources management, particularly (though not exclusively) at the transboundary level. He has advanced analytical, project leadership and programme implementation skills, including at Director level, and brings detailed institutional knowledge of working with donors, NGOs, national government (at all levels), as well as the research community. He is equally happy in a community carrying out research activities as he is influencing international policy agendas. He is presently managing a team of some 20 researchers at IWMI. He has specific and detailed geographical knowledge on transboundary water issues in sub-Saharan Africa, the Middle East and Asia, including issues of conflict prevention, benefit sharing, confidence-building and multi-stakeholder engagement (with a particular focus on civil society). Alan authored or co-authored more than 90 publications (h-index 12), mostly in peer-reviewed books and journals. Google Scholar: <a href="https://scholar.google.com/citations?user=UaSLW0MAAAAJ&amp;hl=en">https://scholar.google.com/citations?user=UaSLW0MAAAAJ&amp;hl=en</a></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Highest Qualification/s (up to 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000 Ph.D. Department of Politics, School of Oriental and African Studies, University of London</td>
</tr>
<tr>
<td>1990 MA, Department of Politics, University of Exeter</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Recent Positions held (2-3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012-2015 Program Director, GWI East Africa, CARE International, Kampala, Uganda</td>
</tr>
<tr>
<td>2010-2012 Research Fellow, Knowledge, Technology and Society Team, IDS, Brighton, UK</td>
</tr>
<tr>
<td>2009-2010 Director of Policy and Programmes, World Water Council, Marseille, France</td>
</tr>
<tr>
<td>1999-2009 Research Fellow, ODI, RiPPLE Director, WPP Head, London, UK/Ethiopia</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Relevant and recent Publications (Max 5)</th>
</tr>
</thead>
</table>

DCLAS PRE-PROPOSAL
**CLAUDIO ZUCCA**  
Soil Conservation and Land Management Specialist at ICARDA,  
15 Khalid Abu Dalbouh St., Abdoon Eshamali, P.O. Box 950764, Amman, Jordan  
c.zucca@cgiar.org

<table>
<thead>
<tr>
<th>Profile</th>
<th>Eleven years of postdoctoral research experience on land degradation and desertification, vast experience in assessing, surveying, monitoring, and mapping soil and land at multiple scales. Expert in sustainable land management and integrated participatory assessment of land restoration impact on ecosystem goods and services. Co-supervisor of 17 Master and 3 Doctorate students, author of more than 30 international publications indexed ISI/SCOPUS.</th>
</tr>
</thead>
</table>
| Highest Qualification/s (up to 2) | - Italian national academic habilitation for the Associate Professor position.  
- French national academic qualification as Maître de Conférences. |
- 2009 - March 2015: Senior Researcher, Dept. of Agricultural Sciences (Dipartimento di Agraria, Sezione di Ingegneria del Territorio-Pedologia e geologia applicata)  
- 2004 – 2008: Post-doctoral Researcher, Inter-department Centre NRD (Desertification Research Centre) |
Flagship 6: IMPROVED RURAL LIVELIHOOD SYSTEMS

1. PETER THORNE  
   ILRI

2. MAURICIO R. BELLON  
   Bioversity International

3. THOMAS FALK  
   ICRISAT

4. KARIN REINPRECHT  
   ICARDA

5. LANCE W. ROBINSON  
   ILRI

6. RICHARD THOMAS  
   CRP-DS, ICARDA

7. Paul L G Vlek  
   ICARDA
**Profile**

Thirty years experience in research and research management around livestock intensification and the roles of livestock in mixed farming systems. Specific research interests in systems simulation modeling, crop-livestock interactions (synergies and trade-offs) and farming systems evolution for sustainable intensification. Extensive project management experience in both research and service delivery. Recently appointed to the advisory board of the USAID Sustainable Intensification Innovation Laboratory (Kansas State University).

**Highest Qualifications**

<table>
<thead>
<tr>
<th>Year</th>
<th>Qualification</th>
<th>Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1986</td>
<td>Ph.D. Animal Nutrition</td>
<td>Nottingham University, UK.</td>
</tr>
<tr>
<td>1982</td>
<td>BA. Agriculture and Forest Sciences</td>
<td>Oxford University, UK.</td>
</tr>
</tbody>
</table>

**Recent Positions held**

<table>
<thead>
<tr>
<th>Date</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 / 2011 – date:</td>
<td><strong>International Livestock Research Institute</strong> (ILRI) – Principal Scientist and Project Manager, Africa RISING (Research in Sustainable Intensification for the Next Generation).</td>
</tr>
</tbody>
</table>

**Relevant and recent Publications**

### MAURICIO R. BELLON
Bioversity International, Via dei Tre Denari 472/a, Maccarese (RM) 00057, Italy.  
+39-06661336; m.bellon@cgiar.org

<table>
<thead>
<tr>
<th>Profile</th>
<th>He leads research on the reasons, incentives and dynamics of crop diversity in agricultural systems—both at the inter-specific and infra-specific levels—in the developing world; the use of participatory methods in the development of agricultural technologies relevant for the rural poor; and on the impacts of new agricultural technologies on farmers’ livelihoods.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highest Qualification/s (up to 2)</td>
<td>• Ph D, Ecology</td>
</tr>
</tbody>
</table>
| Recent Positions held (2-3) | • 2012–present. Principal Scientist. Bioversity Int. Lead research on the sustainable use and conservation of agricultural biodiversity.  
• 2005-2012. Director, Diversity for Livelihoods Programme, Bioversity Int. Led and managed an applied research programme on the sustainable use and conservation of biodiversity, supervising a multi-disciplinary staff.  
• 2000-2005. Senior Scientist. CIMMYT. Led participatory research applied to the evaluation of agricultural technologies, and the impact of improved germplasm on poverty alleviation. |
www.pnas.org/cgi/doi/10.1073/pnas.1103373108 PNAS  
**DR. THOMAS FALK**
INTERNATIONAL CROPS RESEARCH INSTITUTE IN THE SEMI-ARID TROPICS – Research Program
Resilient Dryland Systems; Patancheru 502 324; Telangana/India; +91 91 00 267 537; T.FALK@CGIAR.ORG

<table>
<thead>
<tr>
<th><strong>Profile</strong></th>
<th>Institutional Economist by specialization, Dr. Thomas Falk has done extensive research in the field of natural resource governance in developing countries. His main fields of expertise are economics of biodiversity conservation, desertification, and climate change; multi-layer governance in social-ecological systems (SES); science-policy interaction and trans-disciplinarity; economic institutions and institutional change in natural resource management. In addition, he supported nature conservation efforts in the frame of UNDP projects.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Highest Qualification/s</strong></td>
<td>2007 Dr. rer. pol. Economics /University of Marburg 1998 Diploma in Economics and Business Management at the University of Marburg</td>
</tr>
<tr>
<td><strong>Recent Positions held (2-3)</strong></td>
<td>Since 04/2015 International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) – Ecosystem Services Specialist; 09/2010 – 08/2015 University of Marburg, Coordination of stakeholder engagement and research on natural resource governance in the “The Future Okavango” project; 05/2010 – 03/2015 Southern African Science Service Centre for Climate Change and Adaptive Land Use, member of scientific consortium</td>
</tr>
</tbody>
</table>
| **KARIN REINPRECHT**  
| Gender Program Coordinator, CRP Dryland Systems (ICARDA)  
| K.reinprecht@cgiar.org, +962 77 77 698 07, PO Box 950764, c/o ICARDA  
| Amman 11195, Jordan |

### Profile

Karin has been working over the past 20 years as an independent consultant in economic development, including finance and organization development. She elaborated numerous strategies, gender audits, gender analyses, gender (baseline) studies, several gender & youth tools, and consulted on gender mainstreaming and integrating gender in indicators, budget, and organizational processes.

### Highest Qualification/s (up to 2)

- Dr. Phil. (University of Vienna)
- International Economics and Politics (post-graduate diploma from Vienna Diplomatic Academy)

### Recent Positions held (2-3)

- Gender Program Coordinator of CRP Dryland Systems (framework consulting contract) – started January 2015
- Independent consultant since 1993: [www.karinreinprecht.com](http://www.karinreinprecht.com) (project list and CV)
- Coordinator of private sector development in Vienna leading a team of five who were based in Africa and Latin America (framework consulting contract with the Austrian Development Cooperation in the Foreign Ministry), 1995 - 2004

### Relevant and recent Publications (Max 5)

   (studies not published, but accepted by contracting organisation:
   29. Evaluation of a women entrepreneurship development project in Kenya, Tanzania and Uganda reaching out to 90% rural and 40% young women testing participatory systems research methods (ILO, 2015)
   30. Study on extent and type of financing for women-owned SME in Sub-Saharan Africa (African Development Bank, 2012))
**Profile**
Dr. Lance Robinson specializes in natural resources management and environmental governance and resilience, with a particular emphasis on drylands. Systems approaches feature prominently in his work. He brings 20 years of NGO and academic experience to bear on the research to development continuum.

**Highest Qualifications**
- PhD, Natural Resources and Environmental Management, University of Manitoba, 2009
- MSc, International Rural Development Planning, University of Guelph, 1994

**Recent Positions held**
- Sept. 2013 to present. Scientist (Governance and Resilience), International Livestock Research Institute.
  - Designing and leading research on environmental governance, resilience, policy process, livelihoods.
  - Supervising consultants, students, research technicians, etc.
  - Conducting research on environmental governance and resilience.
- 2009 to 2012. Post-doctoral fellow, Vancouver Island University.
  - Conducting research on environmental governance

**Relevant and recent Publications**


# RICHARD THOMAS
Director, CRP on Dryland Systems

## Profile (around 50 words)
Richard Thomas is the program director for the CRP-Drylands System since August 2014. He was previously the Assistant Director at the United Nations University – Institute for Water, Environment and Health based at McMaster University, Hamilton, Canada. He has served the CGIAR as Director of the Natural Resources Management Programme at the International Centre for Agricultural Research in Dry Areas (ICARDA) and as program leader at the International Center for Tropical Agriculture (CIAT) in Colombia. He is a graduate of the University of Wales, U.K. with a B.Sc. and Ph.D. in botany and microbiology. His broad research interests include integrated soil, water and nutrient management in crop-livestock systems in Latin America, Africa, West and Central Asia. In 2001 his research team at CIAT received the CGIAR’s Excellence in Science Award for Outstanding Partnership. He has published over 100 refereed journal articles, written 41 book chapters, co-edited 4 books and 26 other articles of general interest. Currently he acts as scientific coordinator for the Global Economics of Land Degradation Initiative.

## Highest Qualification(s) (up to 2)
- Ph.D. Botany and Microbiology Univ. of Wales

## Recent Positions held (2-3)
- CRP Director for Dryland Systems c/o ICARDA Aug 2014 - present
- Assistant Director, Head of Dryland Systems, United Nations University-Institute for Water, Health and Environment 2008-2014
- Director Natural Resources Management Program, ICARDA 2001-2008

## Relevant and recent Publications (Max 5)

| **Profile** | Trained as a Tropical Soil Scientist. Conducts research on the sustainable use of natural resources in the tropics and how this is affected by or affects development processes. Supervised over 75 Ph. D. students that worked in a broad area of expertise in all parts of the (sub) tropics. Over 200 peer reviewed publications. Professor of Tropical Agronomy at the University of Goettingen (1990 -1998) University of Bonn (1998-2015) and founding director of the International Center for Soil Fertility Research (IFDC) in Africa, Togo (1986-1990). In most his recent assignment as Executive Director of the West African Climate Service Center WASCAL Prof Vlek established graduate schools of excellence in 10 West African countries to generate the expertise needed to deal with problems related to climate change in the region |
| **Highest Qualification/s** (up to 2) | • Ph D-  
• Professor |
| **Recent Positions held** (2-3) | • DDR-Research ICARDA  
• Executive Director WASCAL  
• Executive Director ZEF (Center for Development Research) |
FLAGSHIP 7: POST-HARVEST VALUE & OUTPUT MARKETS

1. Ousmane Coulibaly, IITA
2. Bussie Dixon, IITA
3. Tahirou Abdoulaye, IITA
4. Amos Gyau, ICRAF
5. Girma T. Kassie, ICARDA
6. Kiran Sharma, ICRISAT
<table>
<thead>
<tr>
<th>Profile (around 50 words)</th>
<th>Agricultural economist with more than 15 years’ experience in socio economic analysis, agricultural value chains analysis and improvement, post-harvest technology development and assessment, impact analysis and agricultural project coordination.</th>
</tr>
</thead>
</table>
| Highest Qualification/s (up to 2) | - Doctor or Philosophy (PhD), completed in 1995, Department of Agricultural Economics, Purdue University, USA  
- Master of Science, completed in 1987, Department of Agricultural Economics, Michigan State University, USA |
| Recent Positions held (2-3) | **Period, position and Organization with a brief nature of responsibilities being handled**  
- **2002-present**: Agricultural Economist (Senior Scientist – Highest Level in IITA system) and Regional Coordinator, Cowpea Project for Africa (PRONAF) and Cowpea Scaling project. IITA Benin and Ghana  
Responsibilities: Coordinate cowpea project for 9 countries. Research for development and capacity building of NARS scientists  
- **1999-2002**: Agricultural economist (Associate Scientist) and coordinator-Economics of Integrated Pest Management at IITA. Responsibilities : Modelling of IPM and profitability assessment of crop losses. IITA Benin  
- **1995-2002**: Agricultural Economist (Post-Doctoral Fellow), Resource and crop management division, IITA Cameroon  
Responsibilities: Research, capacity development of partners |
Dr. Maziya-Dixon

After graduating with BSc (Home Economics), MSc (Food Science) and PhD (Food Science) degrees from Kansas State University, Manhattan, Kansas, USA, Dr. Maziya-Dixon worked as Associate Lecturer, Department of Food Technology, University of Ibadan, Nigeria before joining IITA as a Food Scientist/Crop Utilization Scientist.

Dr. Maziya-Dixon, a citizen of Swaziland, conducts research on nutritional quality, processing, utilization, and product development and evaluation of maize aimed at providing a diversity of secondary food products for rural and urban poor or high value products for the richer consumers. This can open new opportunities for market sales and also offer the possibility of improving dietary intake. In collaboration with partners and other stakeholders, she also coordinates workshops to create awareness of innovative postharvest technologies to enhance adoption of nutritious and safe food products. She also conducts research on nutritional assessment of children under 5 and women of childbearing age to guide in targeting of agricultural-based interventions thus promoting the agriculture-nutrition-health linkage. Together with national partners, she is involved in devising a mechanism for promoting strong linkages between agriculture and nutrition with a gender perspective in order to reduce food insecurity and malnutrition on a sustainable basis.

Dr. Maziya-Dixon has experience in managing and coordinating projects that involve a variety of development partners, colleagues from national and international institutions with specialization in range of different disciplines, such as agriculture, public health, nutrition, economics, and biometrics. Hence, has gathered experience in administrative and management skills together with project design, implementation, and monitoring. In addition, she has led or participated in interdisciplinary teams in proposal writing, project design, implementation, and monitoring of research for development projects. She leads the CRP on Agriculture for Nutrition and Health.

Educational Background

1983-1992  Kansas State University, Manhattan, Kansas, USA
1974-1976  University of Botswana, Lesotho, and Swaziland, Swaziland

Academic Qualifications

1989–1992  PhD (Food Science), Kansas State University, Manhattan, Kansas, USA
Major:  Cereal chemistry
Minor:  Nutrition
Dissertation research: Nutritional properties of white wheat and alternative uses of a starch-gluten washing stream

1986–1989  MSc (Food Science), Kansas State University, Manhattan, Kansas, USA
Major:  Food chemistry
Minor:  Nutrition
Thesis research: Ground pork studies: quality parameters as affected by different packaging materials and thawing methods; proximate analysis using near-infrared reflectance spectroscopy

1983–1986  BSc (Home Economics), Kansas State University, Manhattan, Kansas, USA
Major:  Nutrition

1974–1976  Diploma (Home Economics), University of Botswana, Lesotho, and Swaziland (now University of Swaziland)

Short-term Training

- Gender Makes a Difference: Using gender analysis to enhance results; 27 July–1 August 2003, Kampala, Uganda
- Project Management Fundamentals (Workshop by International Institute of Learning); 13–14 December 2004, IITA, Ibadan, Nigeria
- Grantee Strategic Communications Training (Training by Spitfire Strategies); 1–3 October 2008, Cape Town Lodge, Cape Town, South Africa
Professional Objective
To contribute to the improvement of household food and nutrition security, income generation, and livelihoods of resource-poor people through utilizing my technical training, communication skills and leadership abilities in a challenging research for development position in Food Science and Nutrition

Work experience
1 January 2012 to Present: CGIAR Research Program on Agriculture for Nutrition and Health Leader
- Work with IITA management to insure monitoring of performance and deliverables, follow-up with management or scientist of opportunities within the CRP or in associated project or proposals, and ensure that management of IITA is informed of significant constraints to delivery or risk that can be mitigated.
- Work with management on CRP budget allocation for W1 and W2 funds, staffing needs, capitol allocations, pooled cost allocations, and any other significant research need.
- Budget holder for CRP W1 and W2 budget which includes sub-accounts allocated to scientists. Budget holder for the pooled cost and capital budget cost center.
- Work with the responsible Director to organize internal planning meetings and attendance for external CRP meetings, consolidate work plans or other planning documents needed by CRP management, consolidate reports as needed, and assist to submit financial reports.
- On request by the director, the coordinator will attend CRP management meetings, CRP planning or other meeting, represent the CRP for IITA, and promote IITA within the CRP.

1 January 1999 to Present: Food Scientist/Crop Utilization Scientist, Crop Utilization Laboratory, International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria
- Conduct research on maize, cassava, yam, cowpea, and soybean quality, processing, utilization, and product development and evaluation in order to provide a diversity of secondary food products.
- Conduct food consumption and nutrition surveys to assess type and amounts of foods consumed, nutritional status, and nutrient intakes.
- In collaboration with partners, facilitate the dissemination of maize, cassava, yam, cowpea, and soybean postharvest technologies.
- Undertake capacity development in collaboration with national research institutes, universities, Non-Governmental Organizations, and Community-based organization.

1 March – 31 December 1996, Consultant Food Scientist, Crop Improvement Division, International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria
- Conducted research on maize quality, processing, utilization, product development and evaluation.
- Conducted training on maize grain quality and utilization, including group training courses and supervision of postgraduate students.
- Coordinated demonstrations to increase awareness of maize postharvest research and technologies developed at the institute.

1 October 1994- 28 February 1996, Associate Lecturer, Department of Food Technology, University of Ibadan, Nigeria
- Taught principles of cereal science and technology with emphasis on: functional characteristics of cereal components in food systems; minor constituents of cereals and their effect during processing; yeast-leavened products; soft wheat products; nutritional composition of cereals; breakfast cereals, and snack foods.
- Lectured on food quality with emphasis on sensory analysis of food products: basic principles of sensory evaluation, guidelines for the selection and training of sensory panel members, basic sensory methods for food evaluation, collecting and analyzing sensory data, planning a sensory analysis experiment, and conducting sensory tests.

Research Management/Administrative Experience
Leadership and Research management
Led or participated in interdisciplinary teams in proposal writing, project design, implementation, and monitoring of research for development projects. Managed and coordinated projects that involve a variety of development partners, colleagues from national and international research institutions with specialization in range of different disciplines, such as agriculture, public health, nutrition, economics, and biometrics. Hence, gathered experience in administrative and management skills together with project design, implementation, and monitoring. I am currently, a Team Leader for the CRP on Agriculture for Nutrition and Health.

Specifically:
- Took lead role in internal monitoring and evaluation of the projects
- Provided regular and accurate project reports (progress against objectives and milestones) to development partners
- Prepared and implemented annual project work plan
- Conducted quarterly budget review and analysis to verify program expenditure
- Planned and managed the day-to-day research activities of the Crop Utilization Laboratory
- Supervised implementation of project activities
- Coordinated the planning, implementation, and monitoring of the project with team members and development partners
- Prepared periodic budgetary requirements, as well as monitored and ensured strict budgetary disbursement;
- Developed and implemented monitoring and evaluation systems to enable the interdisciplinary group assess the impact of programmatic efforts, determine the effectiveness of the project, and ensure learning is shared across the project’s activities and partners.
- Managed, guided, and supervised the staff and consultants in the Crop Utilization Laboratory
- Performed annual performance evaluation of young professionals and nationally recruited staff
- Provided oversight of the Crop Utilization Laboratory and research team; budget; and procurement of laboratory supplies
- Monitored research fellows work plan and non-degree students

Training/capacity building experience

Strong commitment and dedication to training of National Agricultural Research Institutes and other partners through:
- Organizing and supervising group training courses on processing and utilization technologies of maize.
- Supervising short-term study attachment in maize processing and utilization.
- Co-supervising with University partners MSc and PhD degree-related research in food science/technology at IITA.
- Examination of dissertations/theses

Computer experience
- Working knowledge of IBM and IBM compatible computers and software (i.e.: word processing, graphics and spreadsheet: Microsoft Word; Microsoft PowerPoint; and Microsoft Excel).
- Use of the Statistical Analysis System (SAS) for data entry and analysis.
- Use of the Food Intake Analysis System (FIAS) for analyzing nutrient intakes

Awards and honors
1. American Association of Cereal Chemists Nutrition Division Award for best graduate student paper, 1991
2. Certificate of Merit (Awarded by Phi Tau Sigma), 1991
3. The Phi Tau Sigma Honorary Society of Food Science
4. Omicron Nu (National Honor Society of Home Economics) 1985
5. Scholastic Honors, College of Human Ecology, Kansas State University
6. Dean's List, 1978, University of Botswana, Lesotho, and Swaziland
Professional positions in committees and working groups
1. Team leader of the Agriculture, Nutrition, and Gender Working Group Project in Africa [April 2001 to 2005].
2. Member of the National Fortification Alliance of Nigeria [September 2002 to date].
3. Member of the Working Group for Developing the National Plan of Action for the National Policy on Food and Nutrition of Nigeria [June 2003 to 2005].
4. Member of the Recruitment Committee for the secondment of a nutritionist to the National Council on Food and Nutrition Secretariat, Nigeria.
5. Member on the Committee of the Launching of the National Food and Nutrition Policy of Nigeria.
6. Member of the Nutrition Partners Group of Nigeria [2001 to date].
7. Member of the Organisation for Economic Co-operation and Development Task Force developing a Consensus Document on Compositional Considerations for New Varieties of Cassava [2006 to date].
8. Member of the Editorial Board for the African Journal of Root and Tuber Crops [2004 to date].

Membership in employer’s committees
1. Member of the Communication Steering Committee chaired by the Director, Project Development and Management [January 08 to 2010]
2. Member of the IITA Laboratory Committee chaired by the Head of the Physical Plant Services [June 2005].
3. Member of the IITA Laboratory Committee chaired by the Director of the Resource and Crop Management Division [February to August 2002].
4. Member of the IITA committee on Vehicle Management Committee constituted by the Director of Crop Improvement Division [January to April 2002].
5. Member of the committee appointed by IITA’s Director General to present staff views to the Board of Trustees with respect to the selection of the 6th Director General of IITA [April 2001].
6. Member and Chairperson of the Institutes’ Risk Assessment and Management Committee [2012 to present]

Resource mobilization
Together with colleagues at IITA, I have written and contributed to research for development proposals, which have attracted over US$20 million.

Publications
Author or co-author of over 100 publications including referred journal articles (81), books/monographs (18) edited/non-edited abstracts (27) conference papers and seminars (64).
Amos Gyau
World Agroforestry Centre, United Nation Avenue Gigiri, 00100. Box 30677 Nairobi, Kenya. Email: A.gyau@cgiar.org Tel: +254-712939416

Amos is a research leader in Market, Institutions and Production Economics at the World Agroforestry Centre. His research focuses on strategies for linking farmers to markets, value chain development and the related institutional arrangements. Prior to joining ICRAF in 2010, Amos worked with the Food and Wine Business group at the University of Adelaide. He has experience working in Africa, Asia and the Pacific, and has authored/co-authored over 60 scientific papers including 35 peer-reviewed articles in leading agribusiness management and marketing journals.

- Ph.D Agribusiness management/Marketing
- M.Sc Agricultural Economics
- B.A. (hons) Economics and statistics

<table>
<thead>
<tr>
<th>Research leader-(Markets ,Institutions and Production Economics)-World Agroforestry Centre-June 2014  to date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead research activities globally on themes related to markets, value chains and institutions. I guide and backstop all ICRAF activities in these themes globally.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>I provided scientific leadership in the field of agribusiness and marketing and value chains in the West and Central Africa region, Eastern and Southern Africa and South East Asia. I led the marketing research and agribusiness development activities in these regions including value chain and sector analysis, post harvesting and product development, consumer studies and marketing strategies (including collective action, market information systems) for linking farmers to markets</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Postdoc Research Fellow/Lecturer- Food and Wine Business (University of Adelaide) – Oct. 2008 to Sept. 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>In this position my task was to provide mentorship, guidance and supervision for PhD and M.Sc. students in the field of food and wine marketing. Some of my research took place in Indonesia, Malaysia, Fiji and Australia. I lectured several courses in the fields of agricultural and food supply chains some of which were done in collaboration with other professors.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Relevant publications</th>
</tr>
</thead>
</table>
Girma T. Kassie (PhD)
Senior Agricultural Market Economist
Social, Economic, and Policy Research Program
International Center for Agricultural Research in Dry Areas (ICARDA)
Email: g.tesfahun@cgiar.org

Profile
I am an agricultural economist (PhD) working for the international center for agricultural research in the dry areas (ICARDA) as a senior scientist based in Addis Ababa, Ethiopia. I have close to 20 years of research and teaching experience in the fields of agricultural production economics, agricultural marketing and value chain analysis, discrete choice analysis, agricultural risk analysis, and monitoring, evaluation and impact assessment of agricultural programs and technologies.

Highest Qualification/s (up to 2)
- Ph.D. World Food Economics (2008), University of Kiel, Germany, Dept. of Food Economics and Consumption Studies
- M.Sc. Agricultural Economics (2002), Haramaya University, Dept. of Agricultural Economics.

Recent Positions held (2-3)
1. Senior scientist at ICARDA (Ethiopia) Jan 2014 to date.
   ▪ Leader, marketing and value chain research.
   ▪ Center focal person, Efficient and Inclusive Value Chain FS, PIM CRP
   ▪ Led socioeconomic research activities of the drought tolerant maize for Africa (DTMA) project in southern Africa.

Relevant and recent Publications (Max 5)
**Dr. KIRAN KUMAR SHARMA**

**Principal Scientist (Cell Biology), International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Chief Executive Officer, Agribusiness and Innovation Platform (AIP), ICRISAT and Director, Platform for Translational Research on Transgenic Crops (PTTC), ICRISAT**

ICRISAT, Patancheru Telangana, India 502 324
Tel: +91-40-30713300, Fax: +91-40-30713074, Email: k.sharma@cgiar.org

**Profile (around 50 words)**
Dr. Kiran Sharma has been involved in conceptualizing and setting-up of an Agri-Business Incubator (ABI) at ICRISAT which is a unique project, jointly supported by ICRISAT and the Government of India. This has created an effective platform to interface public and private sectors for enhanced synergies in technology development and deployment.

**Highest Qualification /s (up to 2)**
- Post-Doctoral Fellow at the University of Calgary, Canada
- Ph.D. from the University of Delhi, India

**Recent Positions held (2-3)**

<table>
<thead>
<tr>
<th>Date</th>
<th>Position Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>01/2011-Present:</td>
<td>Chief Executive Officer (CEO), Agribusiness &amp; Innovation Platform (AIP), ICRISAT, Patancheru, Andhra Pradesh, India – Development of PPP model of ICRISAT, entrepreneurship development, private sector partnerships, value-addition in crops</td>
</tr>
<tr>
<td>07/2009-Present:</td>
<td>Director, Platform for Translational Research on Transgenic Crops (PTTC), ICRISAT, Patancheru, Andhra Pradesh, India - set-up a physical infrastructure for the advancement of transgenic technology from concept to commercialization.</td>
</tr>
<tr>
<td>01/2003-Present:</td>
<td>Principal Scientist (Internationally Recruited Staff)-Cell Biology, Transgenic Technology, Global Theme-Biotechnology, ICRISAT, Patancheru, Andhra Pradesh, India. – Responsible for Genetic Transformation Laboratory (GTLab) at ICRISAT and carrying out plant genetic transformation work in the institute</td>
</tr>
</tbody>
</table>

**Relevant and recent Publications (Max 5)**


Annex 16. DCLAS RESPONSE TO THE SPPC REVIEW OF ITS PREPROPOSAL, JULY 2015

### CRP 2nd Call: SPPC Feedback on Draft Pre-Proposals

**DCLAS = Dryland Cereals & Legumes AFS CRP**

A very good draft pre-proposal and a robust basis for delivering an excellent final version.

**Regarding the positive comments:**
- The key specific AFS-based research questions are addressed well at the FP level
- The 6 proposed FPs are complementary and well-articulated to demonstrate a move from a commodity- to a system-based program focused on drylands’ needs with 3 of these 6 FPs feeding this systemic approach. Even if the budget is not presented, it is clear that FP4, 5 and 6 will be supported according to their importance.
- An interesting initiative is the “FP-FP linkages” section (described for FP1, 5 and 6) bringing more credibility to the articulating mechanisms through the overall program (to be completed for other FPs)?
- The annex on CRP-CRP linkages is excellent.
- Although there are limited details, RBM and M&E are given prominence in the Pre-Proposal in several sections, including the Executive Summary.
- Accountability is demonstrated by setting goals at the country level for each of the 3 SLOs (e.g. Ethiopia)
- The four lessons learnt mentioned on p.11 are critical for the success of DCLAS in the next phase and if the identification is the first step, then mitigation actions have to be planned and their implementation described in the pre-proposal.
- The youth strategy linked to digital agriculture is commendable.
- A very good section (Annex 1) is presented for capacity development

**Some areas that could be better addressed:**
- The comparative advantage of merging DC, GL and DS, has to be described for each set of crops (4 dryland cereals and 8 grain legumes), their combinations [DC x GL] and their respective complementarities with other crops, trees, or livestock to address the dryland specific needs in a system-based approach

A key comment in the CCEE for Grain legumes is that the “that the future for research in the grain legumes is best addressed by focusing on each of the species separately, and within an ecosystem framework”. This is precisely the ambition of DCLAS.

- A review for “Mapping CRPs activities in drylands: strengths, gaps and opportunities” was carried out for FC 13 (Bogor); have the relevant parts of that document been taken in to account in this pre-proposal? This is now included.

- The strategic context of dryland cereals and legumes (areas under cultivation, nutritional, cultural and economic importance, growing competition from other products) could be presented in greater detail. We have attempted to do this in the current submission.

- There is a discussion of ToCs and IPs, including the pre-conditions and assumptions through the narrative. An IP is presented for DCLAS (Fig. 2, p.13), but unfortunately it is mainly a list of different types of inputs, results and outcomes with limited pathways. It is unclear whether ToCs are forthcoming and if and how they would be used.

- For each of the 6 FP, each IP/ToC has to be built from the higher level of adoption (SLOs > IDOs > sub-IDOs) to an outcome-based approach. The ToC has to describe and explain properly the causal linkages through which it is expected that an intervention will bring about the desired impact. IP and ToC for each FP will have to distinguish assumptions, risks and enabling actions, bringing clarity and credibility for the future use of ToC in the CRP RBM framework

The Theory of Change and Impact Pathway has been elaborated in the pre-proposal. These are being developed concomitantly with the development of the proposal, and will be elaborated further if DCLAS is asked to submit a full proposal. We fully accept the outcome based approach and DCLAS is designed around the delivery to the sub-IDOs. The M&E system for DCLAS would therefore ensure that our proposed ToC and IP is adhered to and reviewed.

- The pre-breeding section should demonstrate the step-changes in crop improvement and crop/trait domestication that can be achieved through DCLAS.

We have included tables of crop / country / trait targets - this is necessarily complex however we believe that the focus on country specific targets is necessary for impact, so this will be complicated to describe fully in the preproposal, we hope the table is a useful indicator.
- There is a good exposition of the available technologies for plant breeding but the prioritization in their use for DCLAS is unclear. This is multi-layered, and the technologies are often crop specific so their description takes space (and time) to describe fully. Nevertheless our prioritisation is on the basis of potential for impact so is not really dependent on the technology for its priority, though the availability of an appropriate technology enables the setting of a priority.

- Partnerships with other CRPs are mapped for dryland cereals R4D activities and an effort is made to describe the intensity/nature of the cross-CRP collaborations by CRP and activity, including the corresponding “give & take” roles (probably need to be matched with each DCLAS FP). This mapping effort has to be completed for GL- and DS-related needs in order to present a general DCLAS approach. The “collaboration mode” is divided into “joint” or “complementary” mode, but more details regarding budget implication, are necessary when co-investment is planned for twin FPs or CoAs (common resources, common agenda, shared responsibilities for delivery, etc.)

This mapping has been outlined in the preproposal.

- To support the IP and ToC, it would help to include a review of the current knowledge on how smallholder farmers adopt technologies and how this will inform DCLAS’s operations to ensure that the technologies/outputs they produce will be adopted and satisfy the ‘most important precondition’ to DCLAS’s ToC.

This has been studied in the existing phase I CRPs and the situation is complex. For example, in the 2014 Annual Report for both Dryland Cereals and Grain Legumes, adoption analyses of improved varieties was reported in Tanzania (for sorghum) and in Tanzania and Zambia for legumes. It was noted that “farmers in Tanzania and Zambia grow an improved variety in one season and local varieties in another season”. Most likely there is not one answer to this issue and farmers likely weigh risk and behave with a degree of caution. Understanding (and respecting) this is critical for the success of our proposed interventions.

- In addition to their breeding value, the new delivered varieties with innovative traits will need to be adopted by smallholders. This last mile step will request a strong stewardship commitment and services from DCLAS involving its CRP scientists and developers directly or collaborating with development agencies (eg GIZ?). The role of DCLAS in this key part of the adoption process has to be better described and financially supported.

Agreed. The National bodies and NGOs are also critical in this step, but most important is understanding and responding to the real needs of the farmers.

Alignment with SRF and contribution to targets described in the Results Framework

Each FP is mapped with IDOs.

This alignment is at the Activity level with respect to sub-IDOs.

Adoption of a systems-based approach, particularly in the AFS CRPs

FP1 is a key flagship for priority settings, strategic decisions, planning and real-time motoring & learning, RBM implementation and finally impact acceleration. FP2 and FP3 support the breeding pipeline for delivering new varieties, FP4, 5 and 6 are key components feeding the system-based strategy.

Our main concern is related to the fact that this program has to deal with 4 cereals and 8 legume crops, meaning a total of 12 species cultivated in several locations by and for different stakeholders increasing the level of complexity of this specific AFS CRP; surprisingly all the crop improvement activities are grouped in a single flagship through FP2, what is the budget and size of this FP? Independently of its funding support, the structure of FP 2 is extremely convincing with cross cutting CoA as CoA 2.1 on pre-breeding or 2.2 on trait discovery (independently of the crop of interest). The third CoA is crop, geographic and trait specific but will very probably be a huge CoA. A possible solution could be the cleavage of this FP2 into 2 FPs: one for trait discovery and including pre-breeding; the second for variety development.

We accepted the point that FP2 was very large and have divided it more or less as suggested. This has been done in a short time span and the precise disentanglement of trait discovery & pre-breeding vs variety development may not be fully matured. These two are very tightly interconnected and are not entirely independent. We are concerned not to duplicate effort in the two flagships and also to ensure that the connection between them remains intimate.

FP4 is extremely well-designed and highly strategic for dryland areas; the connectivity with WLSE on this specific FP is a key challenge for DCLAS for addressing 7 AFS IDOs and 4 CC IDOs.

This comment is appreciated.
For each FP, different grand challenges are addressed and key overreaching research questions are precisely addressed for each of the CoA by FP. In addition, each FP is connected with several key W3/bilateral projects and the complementarity and overall coherency is shown.

This comment is appreciated, and the connection between W3/Bilateral projects and FPs is elaborated in the preproposal.

Coherence and added value of the CRP based on proposed Flagships

ISPC- and CO-guided preparatory structuring of the commodity CRPs of the current extension phase has educated the organization of the flagships of the new program along a delivery pipeline: (1) Priority Setting and Impact Acceleration, (2) Crop Improvement, (3) Seed Systems and Input Services, (4) Integrated Land, Water and Crop Management, (5) Livelihood Systems, and (6) Post-harvest Value and Output Markets.

Till now, DCLAS is the only AFS program where 50% of the FPs (3 over 6) have a systems-based approach, this is commendable.

This comment is appreciated. We note that the multiple crops involved in DCLAS promote thinking of the way they interact at the level of farming systems and household livelihoods.

Evidence of comparative advantage of CGIAR

The comparative advantage is well-described by FP; the overall arguments are convincing.

This comment is appreciated.

Evidence that cross cutting issues such as Gender and Youth are being addressed

2 pages of key lessons are reported from the 3 DCLAS CRP Phase I programs (DS, DC and GL) and comments from Humid Tropics also feed in to the content of this section.

Noted

Synergy across the CRP portfolio

Very well-described in section 11 p. 83 (see “Overall feed-back” on 1st page)

This comment is appreciated.

Track record and quality and credibility of the team to include Flagship leadership

CVs are not provided

CVs of the writing team members have been included. At this stage of the development of the proposal not all actors have been available for detailed input and so we envisage that the personnel involved is not yet fully described and we anticipate that there will be further discussion on this point in the build up to the preparation of a full proposal should one be requested.

Governance arrangements, management commitment and partnership strategy

The component programs of DCLAS have transitioned towards the IEA recommendation to “create a single, balanced governing body for each CRP that reports directly to the lead center board on the performance of the program. The CRP governance body should bring together appropriate expertise, include a majority of independent expert members, and accommodate lead center and partner representation.”

In addition, lessons learned on governance and management during the first and extension phases are being incorporated into guidelines for the development of strong structures for governance and management for the new CRP that facilitates management with authority for accountability.

The limited managerial authority of the CRP Director - compared with directors of global partnership programs – was highlighted in different IEA reports. We were expecting a better definition of the CRP Director’s mandate or responsibility for example regarding decision-making on project proposals and contracts, on the allocation of resources across and within components and for staff supervision and performance assessment outside of the small leadership team.

We understand these points very well and they have impacted directly on the construction of DCLAS. Should a full proposal be requested these issues will be dealt with in detail.

In this regard, FP leaders’ roles have to be better defined. FP Managers are expected to contribute actively to the design and dissemination of their FP sub-ToC and the overall ToC at CRP level; so, they will be able to explain why FP/CoAs contribute to the outcomes sought, in alignment with alignment with SRF at the portfolio level. These colleagues should have the flexibility/empowerment – jointly with the CRP leader and Program Management Committee – (i) to allocate program resources (budget, staff) with the aim of maximizing results, (ii) to set meaningful performance expectations with M&E staff, (iii) to measure and analyze results, jointly with M&E staff and (iv) to learn from this managerial experiences in order to adjust delivery and modify or confirm program design (including ToC and IP annual reviews); finally they should be the CRP champions for building a ‘culture of results’ in the CGIAR.

Appropriateness of budget in relation to the research objectives proposed

For its budget allocation DCLAS estimation is based on the average annual W1/2 funding during 2011-2014 (around US$ 311M), and requesting an annual budget representing 10% of this W1/2 amount, meaning US$ 32M. But why 10 % and not 15 or 20 or 5%... what is the rationale supporting such estimation? It would be more convincing to calculate the budget based on the needs
to cover the activities already funded and implemented in Phase I for the 3 CRPs, then showing that cost-saving is performed when synergies are possible (for example between DC and GL, for pre-breeding or trait discovery activities) and additional costs are necessary to set-up the system-based approach (and integrating what was already done within Dryland System).

**Have recommendations from IEA and ISPC reviews/comments been reflected in the pre-proposal?**

Following the IEA recommendation to create a single balanced governing body (merging IAC and SC).
### Annex 17. ISPC & FC 'Must-Haves'

#### ISPC & FC 'Must-Haves' From Phase I Proposal Review

<table>
<thead>
<tr>
<th>ISPC &quot;MUST-HAVE&quot;</th>
<th>1</th>
<th>Justification for expected impact on specified target populations and for research prioritization</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
<td>Integration of research across the different crops.</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Better definition of the targeted farmer groups ranging from subsistence farmers to those able to link with commercial markets will help focus research and planning.</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Although proponents provide more data on country statistics, poverty and target populations, it still isn’t clear how those data have been used in selecting the priorities. The proposal still lacks clarity in key assumptions and consistency regarding criteria used for targeting specific crops and geographic areas.</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Provide an improved analysis and presentation of the target populations who can realistically be expected to benefit from the CRP 3.6 research.</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>Justify and prioritize better the proposed work plans on a crop-specific basis; pool research efforts in identified areas across two or more of the dryland cereals for greater efficiency</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>Reduce the scope of research in terms of crops and target areas when likely effectiveness of the research at scale cannot be demonstrated</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>Do an analysis of current work to identify barriers to adoption and shifting to new areas of innovative research and approaches to overcome these barriers.</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>Present new and innovative approaches to overcome constraints to adoption of the range of technologies by the poor and vulnerable, particularly in Africa, and to increase the likelihood of impacts in their livelihoods</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>Present realistic and research-specific impact pathways that carefully address the conditioning factors and incorporate feedback loops.</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>Show better integration of CRP3.6 with CRP1.1 (Dryland Systems), as well as justification for their separate identities or merger; there needs to be a plan to monitor the impact pathways for CRP 3.6 cereals research drawing lessons from both CRPs</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>Provide further attention to Monitoring and Evaluation system</td>
</tr>
<tr>
<td></td>
<td>13</td>
<td>Present evidence of linkages with the Regional For a</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>Provide information on formal commitment of other partners</td>
</tr>
</tbody>
</table>

#### GRAIN LEGUMES

<table>
<thead>
<tr>
<th>ISPC &quot;MUST-HAVE&quot;</th>
<th>1a</th>
<th>Objectively demonstrate the relative importance of these crops in the CGIAR portfolio, drawing on information related to GL-specific producers and consumers in the different target regions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1b</td>
<td>Undertake a comprehensive assessment of past research efforts and current barriers to adoption of technology, as a basis for identifying key constraints and opportunities that could be influenced by CRP 3.5 research products</td>
</tr>
<tr>
<td></td>
<td>1c</td>
<td>Establish targets for outcomes in a crop by region matrix to account for actual situations and current status from a regional and crop species perspective, and strengthen capacity to prioritize allocation of resources for GL research within this CRP and within the CGIAR</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>A workplan with more focus and fewer product lines: that this CRP concluded with such a large number of product lines (61 crop/traits for genetic improvement) indicates the difficulty of moving from individual programs to a global program within a CRP</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Given limited success to date in the adoption of improved GL technologies, demonstrate feasible impact pathways, citing relevant references and documentation</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>This CRP should be closely allied to and integrated into the system CRPs, and particularly CRP 1.1</td>
</tr>
</tbody>
</table>
Highlight the new and most promising areas of research: the list of innovation initiatives and cross-learning opportunities on p122-123 are ambitious and commendable and deserve a more prominent place in the proposal, with an explanation of the value that would be generated by succeeding in each of these initiatives.

Management and Governance

**FC "MUST-HAVE"**

1. Higher degree of prioritization, both at the thematic and at the geographic levels, is required

2. Further attention should be given to M&E system

3. Farmers’ organizations, extension workers and NGOs are under-represented; need to provide details on specific organizations and their role, especially in SSA; proposal needs to show evidence of involvement of sub-regional organizations and their networks

4. Specify practical commitments and investments required of other partners engaged

5. Further analysis is needed on possible trade-offs implied by the new emphasis on value chains; proponents need to consider location specificity that IPGs may be difficult to generate in deciding on which value chains to select for intensive research

6. Participatory technology development through enhanced on-farm research, with farmers managing their own fields, is recommended to be part of the program; it needs to refocus SO3 to include cropping systems research on farm and with farmers

7. Need better integration of the crop improvement aspects with resource management

8. Provide description of the relationship with other initiatives like Tropical Legumes I and II (TL I and TL II)

9. Links to CRP 2 could be better articulated on the issue of policy bias against small farm enterprises, which generally characterize grain legume production

10. Budget allocations for SO1 (genetic resources) for CRP 3.5 should be differentiated from the budget allocation that was made for the genebanks

**DRYLAND SYSTEMS**

**ISPC "MUST-HAVE"**

1. Clearly characterize the target dryland systems. The proposal must define dryland areas of the developing world (including target populations) and identify geospatial distribution using a water balance approach that quantifies risk and severity of water shortage as the basis for categorizing regions that fall into the “reduced vulnerability” focus of SRT2, or the “sustainable intensification” focus of SRT3.

2. Establish clear set of hypotheses as an organizing principle to help prioritize the research and results agenda.

3. Provide the criteria for choice of benchmark sites and development of relevant data to inform research requirements in both the biophysical and social sciences, and their synthesis.

4. Refine site selection (including level of ambition regarding geographical reach and number of ‘action sites’) and characterization and prioritize activities to be carried out, working from impacts to activities.

5. Provide more detail on the underpinning science and agronomic, genetic, and farming system approaches to be evaluated once the first phase has progressed.

6. Provide a more comprehensive theory of how social change will result from the livelihood, gender and innovation systems approaches espoused in the current proposal.

7. Discuss current research priorities and how they would inform and complement new initiatives.

8. Identify clearly the research interventions proposed as a result of the diagnosis of the problems.

9. Describe the framework of selecting external and Centers’ partners, their respective research activities, how these activities collectively contribute to an integrated agro-ecosystem research agenda.
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Differentiate the roles of the crop/commodity CRPs and this system CRP (<em>including avoiding overlap and potential duplication between CRPs</em>).</td>
</tr>
<tr>
<td>11</td>
<td>Integrate available lessons from the SSA-CP.</td>
</tr>
<tr>
<td>12</td>
<td>Develop a logframe (<em>together with a clear recognition of constraints and strategies for addressing risks</em>) and articulate pathways to explicitly link a cluster of outputs to outcomes and impacts and to the SRF system level outcomes (<em>including clear quantification of results as the base of the M&amp;E system</em>).</td>
</tr>
<tr>
<td>13</td>
<td>Include a performance management framework.</td>
</tr>
<tr>
<td>14</td>
<td>Build climate variability resilience and sustainable dryland systems through an integrated program combining indigenous knowledge with improved technologies, information dissemination and engagement with stakeholders.</td>
</tr>
<tr>
<td>15</td>
<td><strong>Must Have 15:</strong> Redefine management structure to ensure that the Steering Committee and the Research Management Committee are not both chaired by the DG for the lead centre to avoid potential conflict of interest.</td>
</tr>
<tr>
<td>16</td>
<td><strong>Must Have 16:</strong> Broaden the focus of the proposal to include Latin America and South Asia</td>
</tr>
</tbody>
</table>
Notes for preparation of Performance Indicator Matrix

Note 1: It is possible to submit up to 7 Flagships per CRP. Insert additional rows as required within each Flagship, or add extra Flagship lines.

Note 2: Outcomes should be aggregated from Cluster to Flagship level for the pre-proposal phase. To facilitate the ISPC’s prioritization review, quantified targets for each Flagship should be provided down to the sub-IDO level (refer Figure 3 of the 2016 – 2030 CGIAR SRF).

Note 3: Please provide the manner in which verification will be provided. E.g. Website links, contact person, or other means of appropriate verification.

<table>
<thead>
<tr>
<th>Notes for preparation of summary budget:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Note A: Total 2017 - 2022 = full cost of delivery of each outcome</td>
</tr>
</tbody>
</table>

Focus Countries include - WCA: Senegal, Burkina Faso, Mali, Niger, Nigeria ESA: Sudan, Ethiopia, Kenya, Uganda, Tanzania, Malawi, Mozambique, Zambia; CWANA: Morocco, Uzbekistan; SA: India; LA: Nicaragua. Plus an additional 16 regional focus countries.

<table>
<thead>
<tr>
<th>Name of CRP</th>
<th>Overall contribution to 2022 Targets in 2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dryland cereals &amp; legumes agri-food systems</td>
<td>- 40 million people (8 million households), of which 50% are women, assisted to exit poverty&lt;br&gt;<strong>SLO1:</strong> Improved the rate of yield increase, for major food staples from current &lt;1% to 1.5%/Year (CRP Target farmers)&lt;br&gt;<strong>SLO2:</strong> 3 million more people, of which 50% are women, meeting minimum dietary energy requirements&lt;br&gt;<strong>SLO3:</strong> 110 million more people (21M , of which 50% are women, without deficiencies of one or more of the following essential micronutrients: iron, zinc, iodine, vitamin A, folate and vitamin B12&lt;br&gt;<strong>SLO4:</strong> 27 million hectares (ha) degraded land area restored</td>
</tr>
<tr>
<td>Totals at CRP level:</td>
<td>8196,06,000 1362,50,000 1156,85,748</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Flagship projects</th>
<th>Expected Performance Outcomes (Quantified), Note 2</th>
<th>Budget Elements (US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Flagship 1: Priority Setting &amp; Impact Acceleration (Enabling Environment)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2017</td>
<td>2018</td>
</tr>
<tr>
<td><strong>Outcome 1.1: Foresight, priority setting &amp; learning to increase efficiency and effectiveness of resource use across DCLAS areas</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Prioritization principles established and agreed based on analysis in at least 3 countries representing different regions that can be scaled across other priority countries</td>
<td>Application of prioritization principles in all countries to draft integrated country strategies to prioritize resource allocation</td>
</tr>
<tr>
<td></td>
<td>MEL Platform - Priority setting framework is documented for each country</td>
<td>109,93,046</td>
</tr>
</tbody>
</table>

| Notes | |
|-------| |
| 3 | It is possible to submit up to 7 Flagships per CRP. Insert additional rows as required within each Flagship, or add extra Flagship lines. |
| 2 | Outcomes should be aggregated from Cluster to Flagship level for the pre-proposal phase. To facilitate the ISPC’s prioritization review, quantified targets for each Flagship should be provided down to the sub-IDO level (refer Figure 3 of the 2016 – 2030 CGIAR SRF). |
| 1 | Please provide the manner in which verification will be provided. E.g. Website links, contact person, or other means of appropriate verification. |
### Outcome 1.2: Value chains, demand & constraints assessed for inclusiveness and growth potential

<table>
<thead>
<tr>
<th>6 value chains assessed for their inclusiveness and growth potential in at least 3 countries representing different regions that can be scaled across other priority countries</th>
<th>12 value chains assessed for their inclusiveness and growth potential in at least 10 countries representing different regions that can be scaled across other priority countries</th>
<th>Value chain framework is scaled up across all relevant crops within 10 priority countries using validated methodology through partners to ensure inclusiveness and growth potential and at least 6 best fit solutions scaled through partnerships</th>
<th>Value chain framework is scaled up across all relevant crops within priority countries and 6 regional focus countries using validated methodology and at least 12 best fit solutions scaled through partnerships</th>
<th>Value chain framework is scaled up across all relevant crops within priority countries and all regional focus countries using validated methodology and at least 20 best fit solutions scaled through partnerships</th>
<th>MEL Platform - Value chain analysis completed for each commodity and country using robust methodology</th>
</tr>
</thead>
</table>
| **Flagship 2: Pre-Breeding and Trait Discovery** | **Outcome 1.3: Climate change (CC) impact analyses to reduce risks and improve resilience**

<table>
<thead>
<tr>
<th>Future climate and risk profiles outlined for targeted dryland areas and made available for DCLAS researchers use to prioritize interventions</th>
<th>2 priority options assessed for their long term suitability across likely future scenarios</th>
<th>6 priority options assessed for their long term suitability across likely future scenarios</th>
<th>Methodology to assess long term suitability is a scaled through global models and applied to all priority countries</th>
<th>Methodology to assess long term suitability is a scaled through global models and applied to all regional focus countries</th>
<th>MEL Platform - Climate risk profiles generated and stored in Open Data platforms</th>
</tr>
</thead>
</table>
| **Outcome 1.4: Inclusive innovation systems that empower women & young people with options for pathways out of poverty**

<table>
<thead>
<tr>
<th>3 inclusive innovations systems across contexts running and principles validated/adjusted (partners trained under outcome 9 where required)</th>
<th>7 functioning innovation systems established across DCLAS regions and sustainably operating (partners trained under outcome 9 where required)</th>
<th>11 functioning innovation systems established across DCLAS regions and sustainably operating (partners trained under outcome 9 where required)</th>
<th>Existing innovation systems are used as learning platforms for DCLAS priority countries to support women and youth empowerment</th>
<th>Lessons learned from innovation systems are codified and training material generated for long scaling up the empowerment of women and youth</th>
<th>MEL Platform - Innovation system implementation documented as well as changes in participant's outlook</th>
</tr>
</thead>
</table>
| **Outcome 1.5: Drivers of adoption & enabling environment to accelerate rates of technology adoption to improve profitability**

<table>
<thead>
<tr>
<th>Diverse farmer typology established, drivers of adoption identified and implications for policy interventions to reach impact at scale assessed for three priority countries representing different DCLAS regions</th>
<th>MLE framework designed drivers of adoption implemented across DCLAS that embraces participatory approaches along the value chain to determine key drivers of adoption and considers farmer typology - evaluated in three countries</th>
<th>Drivers of adoption framework evaluated in 6 additional countries.</th>
<th>Drivers of adoption framework evaluated in all priority countries and made available to regional focus countries</th>
<th>Drivers of adoption framework validated against recommendations in 2018 and further refined</th>
<th>MEL Platform - Drivers of adoption frameworks are documented along value chains for DCLAS crops in priority countries</th>
</tr>
</thead>
</table>
| **Outcome 1.6: Monitoring, impact assessment & learning to scale up and out through valued partnerships aligned to national goals**

<table>
<thead>
<tr>
<th>Country strategy framework is developed for DCLAS priority countries and commodities</th>
<th>Country strategies are used to develop implementation strategies to scale up proven technologies and to prioritize research - starting with 8 priority countries</th>
<th>Business plans for scaling up technology are developed and business intelligence tools and real-time data capture is implemented to support the scaling up of technology and to track progress against national goals - starting with 8 countries</th>
<th>Business plans for scaling up technology are developed and business intelligence tools and real-time data capture is implemented to support the scaling up of technology and to track progress against national goals - implemented in all priority countries</th>
<th>Business plans for scaling up technology are developed and business intelligence tools and real-time data capture is implemented to support the scaling up of technology and to track progress against national goals - refined in all priority countries</th>
<th>MEL Platform - Country strategies and implementation plans are documented. Dashboards tracking implementation are available in 2019</th>
</tr>
</thead>
</table>

**Flagship 2: Pre-Breeding and Trait Discovery**

| **Flagship 2: Pre-Breeding and Trait Discovery** | **Outcome 1.3: Climate change (CC) impact analyses to reduce risks and improve resilience**

<table>
<thead>
<tr>
<th>Future climate and risk profiles outlined for targeted dryland areas and made available for DCLAS researchers use to prioritize interventions</th>
<th>2 priority options assessed for their long term suitability across likely future scenarios</th>
<th>6 priority options assessed for their long term suitability across likely future scenarios</th>
<th>Methodology to assess long term suitability is a scaled through global models and applied to all priority countries</th>
<th>Methodology to assess long term suitability is a scaled through global models and applied to all regional focus countries</th>
<th>MEL Platform - Climate risk profiles generated and stored in Open Data platforms</th>
</tr>
</thead>
</table>
| **Outcome 1.4: Inclusive innovation systems that empower women & young people with options for pathways out of poverty**

<table>
<thead>
<tr>
<th>3 inclusive innovations systems across contexts running and principles validated/adjusted (partners trained under outcome 9 where required)</th>
<th>7 functioning innovation systems established across DCLAS regions and sustainably operating (partners trained under outcome 9 where required)</th>
<th>11 functioning innovation systems established across DCLAS regions and sustainably operating (partners trained under outcome 9 where required)</th>
<th>Existing innovation systems are used as learning platforms for DCLAS priority countries to support women and youth empowerment</th>
<th>Lessons learned from innovation systems are codified and training material generated for long scaling up the empowerment of women and youth</th>
<th>MEL Platform - Innovation system implementation documented as well as changes in participant's outlook</th>
</tr>
</thead>
</table>
| **Outcome 1.5: Drivers of adoption & enabling environment to accelerate rates of technology adoption to improve profitability**

<table>
<thead>
<tr>
<th>Diverse farmer typology established, drivers of adoption identified and implications for policy interventions to reach impact at scale assessed for three priority countries representing different DCLAS regions</th>
<th>MLE framework designed drivers of adoption implemented across DCLAS that embraces participatory approaches along the value chain to determine key drivers of adoption and considers farmer typology - evaluated in three countries</th>
<th>Drivers of adoption framework evaluated in 6 additional countries.</th>
<th>Drivers of adoption framework evaluated in all priority countries and made available to regional focus countries</th>
<th>Drivers of adoption framework validated against recommendations in 2018 and further refined</th>
<th>MEL Platform - Drivers of adoption frameworks are documented along value chains for DCLAS crops in priority countries</th>
</tr>
</thead>
</table>
| **Outcome 1.6: Monitoring, impact assessment & learning to scale up and out through valued partnerships aligned to national goals**

| Country strategy framework is developed for DCLAS priority countries and commodities | Country strategies are used to develop implementation strategies to scale up proven technologies and to prioritize research - starting with 8 priority countries | Business plans for scaling up technology are developed and business intelligence tools and real-time data capture is implemented to support the scaling up of technology and to track progress against national goals - starting with 8 countries | Business plans for scaling up technology are developed and business intelligence tools and real-time data capture is implemented to support the scaling up of technology and to track progress against national goals - implemented in all priority countries | Business plans for scaling up technology are developed and business intelligence tools and real-time data capture is implemented to support the scaling up of technology and to track progress against national goals - refined in all priority countries | MEL Platform - Country strategies and implementation plans are documented. Dashboards tracking implementation are available in 2019 |
### Outcome 2.1: Pre-breeding to accelerate the use of genebanks to increase genetic diversity in breeding programs globally

<table>
<thead>
<tr>
<th>Methodology to accelerate introgression of alleles for one priority trait per crop is tested to cut the time in half from traditional backcrossing methodologies if this includes wide crosses</th>
<th>Promising methods are validated and prebreeding programs track the number of intermediate products that are introduced into breeding programs for all DCLAS crops</th>
<th>MEL Platform - Varieties released with at least one allele from accessions for all DCLAS crops that are agronomically and/or nutritionally superior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phenotypic and passport data of all 12 DCLAS crops are available on GRIN Global and also Integrated Breeding Platform for field testing of mini-core collections</td>
<td>Promising methods are validated and prebreeding programs track the number of intermediate products for all DCLAS crops</td>
<td>457,62,242</td>
</tr>
</tbody>
</table>

### Outcome 2.2: Trait discovery to based on genotyping and precision phenotyping to generate new markers to support trait integration through forward breeding

<table>
<thead>
<tr>
<th>Outcome 2.2: Trait discovery to based on genotyping and precision phenotyping to generate new markers to support trait integration through forward breeding</th>
<th>All DCLAS trait discovery programs migrate data to IBP to manage genotypic and phenotypic data. Network of precision phenotyping sites is established across DCLAS to provide unique and relevant testing locations for key traits</th>
<th>Resequencing of min-core collections conducted for at least 6 of the DCLAS crops for trait discovery. Precision phenotyping for key traits in these collections is conducted over two years to identify novel alleles for traits that have limited variability in breeding populations.</th>
<th>Products from genebanks are characterized and molecular markers developed as appropriate for use in variety development. Ongoing phenotyping of minicores that have been resequenced. Ongoing marker development through a variety of genetic resources</th>
<th>Promising markers are validated and those found useful are promoted to forward breeding programs as required by breeding pipelines for target DCLAS countries. Prebreeding products are used to increase the reach of trait discovery for priority traits, including nutritional traits</th>
<th>Promising markers are validated and those found useful are promoted to forward breeding programs as required by breeding pipelines for target DCLAS countries.</th>
<th>MEL Platform - documentation of markers validated for use in breeding program. Number of varieties and hybrids developed with markers, Productivity, input use efficiency and nutritional gains documented</th>
</tr>
</thead>
<tbody>
<tr>
<td>127,81,133</td>
<td>25,47,623</td>
<td>127,38,113</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Flagship 3: Variety and Hybrid Development

<table>
<thead>
<tr>
<th>Flagship 3: Variety and Hybrid Development</th>
<th>Outcome 3.1: Environmental Classification, TPEs and Phenotyping to improve trait targeting and representative test environments representative of farmer's conditions</th>
<th>Phenotyping network is evaluated and enhanced to increase screening capacity and accuracy based on number of crops that can be served and the area affected by the trait being evaluated</th>
<th>Phenotyping network maintained to accelerate gentic gains</th>
<th>Phenotyping network maintained to accelerate gentic gains</th>
<th>Phenotyping network maintained to accelerate gentic gains</th>
<th>MEL Platform - Data from breeding programs stored in BMS database. Phenotyping network identified and prioritized investments made</th>
</tr>
</thead>
<tbody>
<tr>
<td>Network of precision phenotyping sites is established across DCLAS to provide unique and relevant testing locations for key traits relevant to SHF conditions</td>
<td>Phenotyping network is evaluated and enhanced to increase screening capacity and accuracy based on number of crops that can be served and the area affected by the trait being evaluated</td>
<td>Phenotyping network maintained to accelerate gentic gains</td>
<td>Phenotyping network maintained to accelerate gentic gains</td>
<td>Phenotyping network maintained to accelerate gentic gains</td>
<td>MEL Platform - Data from breeding programs stored in BMS database. Phenotyping network identified and prioritized investments made</td>
<td>157,77,799</td>
</tr>
</tbody>
</table>

### Outcome 3.1: Environmental Classification, TPEs and Phenotyping to improve trait targeting and representative test environments representative of farmer's conditions

| Network of precision phenotyping sites is established across DCLAS to provide unique and relevant testing locations for key traits relevant to SHF conditions | Phenotyping network is evaluated and enhanced to increase screening capacity and accuracy based on number of crops that can be served and the area affected by the trait being evaluated | Phenotyping network maintained to accelerate gentic gains | Phenotyping network maintained to accelerate gentic gains | Phenotyping network maintained to accelerate gentic gains | MEL Platform - Data from breeding programs stored in BMS database. Phenotyping network identified and prioritized investments made | 157,77,799 | 3,15,556 | 15,77,780 |
| Outcome 3.2: Variety/hybrid development accelerated through structured testing and marker integration | All DCLAS breeding programs migrate data to IBP/Breeding Management System to manage genotypic and phenotypic data. Baseline of genetic gains assessed for all DCLAS crops over two growing seasons. Breeding programs design populations that can leverage forward breeding platforms. Country strategies prioritize traits for breeding pipelines. Markers are identified to support forward breeding, especially for biofortification traits. Selection intensity increases 10-fold with the introduction of forward breeding. Populations integrate multiple traits through markers. All breeding programs streamline nutritional selection into breeding populations along with key productivity traits. Varieties with multiple traits are submitted to national variety release committees in at least 6 DCLAS countries. Genetic gains are assessed that show a 30% increase over baseline breeding programs form 2016. MEL Platform - varieties submitted to variety release committees with increases in yield, input efficiency, nutrition and resistance to abiotic/biotic stresses. | 698,51,995 | 13,97,040 | 69,85,200 |
| Outcome 3.3: Variety/hybrid adoption trials based on participatory approaches | All DCLAS breeding programs migrate historical participatory variety selection data to IBP. All DCLAS programs strategically use farmer input to identify priority traits and varieties that meet the needs of women and men farmers. Breeding programs solicit input from farmers and all key actors along the value chain to ensure varieties developed meet the needs of farmers, aggregators, processors and consumers to support both productivity increases and market access for surplus production. National programs routinely use participatory variety selection to increase the relevance of breeding programs. Number of varieties released based on farmer input is over 50%. Seed companies select varieties/hybrids based on PVS input. Using farmer participatory approaches, time required for variety release is reduced by 50% from selections based only on research stations. Novel methods of accelerating genetic gains (breeding gains and higher rates of adoption) are developed. Genetic gains are documented using gender-disaggregated data. MEL Platform - Data from participatory trials is managed in a proper database. Genetic gains are increased through farmer engagement. | 244,48,198 | 4,88,964 | 84,44,820 |
| Outcome 3.4: Variety and hybrid characterization based on input from actors along value chains with emphasis on traits important to women farmers and markets | All DCLAS breeding programs characterize the key traits for each market segment (value chain) by country. Assessment is validated with input from key actors along the value chain. Traits of commercial importance are prioritized. Breeding programs use market intelligence and value chain assessments in addition to agronomic trait evaluations to select new varieties. Gender disaggregated data is used for variety testing and market intelligence. Breeding programs use market intelligence and value chain assessments in addition to agronomic trait evaluations to select new varieties. Gender disaggregated data is used for variety testing and market intelligence. Breeding programs use market intelligence and value chain assessments in addition to agronomic trait evaluations to select new varieties. Gender disaggregated data is used for variety testing and market intelligence. Breeding programs use market intelligence and value chain assessments in addition to agronomic trait evaluations to select new varieties. Gender disaggregated data is used for variety testing and market intelligence. MEL Platform - Varieties released under DCLAS are able to increase productivity by at least 15% but increase incomes by over 50% due to market preferences. | 89,72,571 | 1,79,451 | 8,97,257 |
| Outcome 3.5: Nursery research and seed production to increase the profitability of seed production | Seed Adoption Roadmaps are developed under large bilateral grants that target seed production based on market size and requirements and develop business plans for scaling seed production, distribution and grain market aggregation. Over half of the DCLAS crops are using seed roadmaps to plan national scaling strategies with key national partners (public sector, private sector, NGOs). All DCLAS crops are using seed roadmaps to plan national scaling strategies with key national partners (public sector, private sector, NGOs). All DCLAS crops are using seed roadmaps to plan national scaling strategies with key national partners (public sector, private sector, NGOs). All DCLAS crops are using seed roadmaps to plan national scaling strategies with key national partners (public sector, private sector, NGOs). MEL Platform - Business plans for scaling up seed production of farmer- and consumer preferred varieties are developed for all priority countries. | 69,85,200 | 1,39,704 | 6,98,520 |
| **Outcome 3.6: Variety/hybrid released at an accelerated rate based on farmer and market engagement** | National variety release systems are characterized during country strategy development to understand key steps, time requirements and policies that delay release and slow down seed production and distribution. National strategies are developed to address constraints and partnerships brought together to discuss policy and infrastructure interventions. These strategies are linked to national strategies for increase nutritional security and poverty alleviation. Partners along the seed release, production and distribution chain are brought together to develop a shared vision and business plans for scaling seed production, distribution and market opportunities for smallholder farmers. Partners along the seed release, production and distribution chain are brought together to develop a shared vision and business plans for scaling seed production, distribution and market opportunities for smallholder farmers. Partners along the seed release, production and distribution chain are brought together to develop a shared vision and business plans for scaling seed production, distribution and market opportunities for smallholder farmers. Partners along the seed release, production and distribution chain are brought together to develop a shared vision and business plans for scaling seed production, distribution and market opportunities for smallholder farmers. MEL Platform - Time to release varieties in each priority country are tracked. Area grown to improved DCLAS varieties developed in partnership are estimated and validated by fingerprinting. |
| **Flagship 4: Seed Systems and Input Markets** | Optimal seed and input delivery models defined for all target countries through the analyses of existing and alternative delivery models for seed and agroinputs, to enable establishment or refinement of region-specific agro-input delivery systems. Optimal seed and agro-input delivery process(es) established for at least one country through the creation of the right enabling environment through partnership with national/regional policy-making entities. Demand-based up scaling of optimal seed and agro-input delivery process(es) in the selected target country, and out-scaling of similar or modified processes in other countries across the region in collaboration with partners. Optimal seed and agro-input delivery processes lead to 10% increased availability and cost-efficient utilization of improved seed and agroinputs across at least one target country. Optimal seed and agro-input delivery processes lead to 10% increased availability and cost-efficient utilization of improved seed and agroinputs across additional countries in one region. Optimal seed and agro-input delivery processes lead to 10% increased availability and cost-efficient utilization of improved seed and agroinputs across an entire region. MEL Platform - Open Access. |
| **Outcome 4.1: Seed systems evaluated based on market demand and other agro-inputs to optimize input value chains to better serve smallholder farmers** | Location-specific need for seed and seed treatment technologies identified against existing baselines of technology availability, use and cost-benefit ratios. Pilot mode analyses of seed technologies in at least one country in collaboration with technology providers and enabling regulatory entities. Confirmed demonstration of yield gains in the pilot and adoption of improved seed technology(ies) by at least 50,000 farmers in the pilot target country. Upscaling and out-scaling of cost-efficient seed technologies in the selected pilot country and other countries in the region leading to at least 5% increased crop production in the region. Adoption of improved seed technology(ies) by 500,000 farmers across the selected region. Adoption of improved seed technology(ies) by 1,000,000 farmers leading to regional crop production gains of 10% across all target and spillover countries above 2017 baselines. MEL Platform - Open Access. |
| **Outcome 4.2: Intentional scaling out seed technologies through business plans at the national level** | Supply-demand analyses, definition and roadmap of hybrid seed production strategies completed for 3 target crops across all associated target countries. Regional upsampling of hybrid seed production in target countries where improved adoption trends are already evident, leading to hybrid seed delivery that is at least 5% of all seed sold for the crop in selected target countries. Novel cost-efficient and leak-proof hybrid seed production technologies evaluated for at least one crop. Hybrid seed production with existing technologies contribute to 10% of the crop seed market in selected target countries. Novel cost-efficient and leak-proof hybrid seed production technologies evaluated for at least one crop. Hybrid seed production with existing technologies contribute to 15% of the crop seed market in selected target countries. Proof of concept of novel cost-efficient leak-proof hybrid seed production technology in pilot test mode for at least one crop. Hybrid seed production with existing technologies contribute to 20% of the crop seed market in selected target countries. Proven novel cost-efficient leak-proof hybrid seed production technology in pilot test mode for at least one crop. Hybrid seed production with existing technologies contribute to 20% of the crop seed market in selected target countries. MEL Platform - Open Access. |
| **Outcome 4.3: Commercial hybrid seed production for DCLAS crops to support a vibrant seed sector in the drylands** | 112,15,714 2,24,314 11,21,571
| **Flagship 4: Seed Systems and Input Markets** | 784,68,674 15,69,373 78,46,867
| **Outcome 4.1: Seed systems evaluated based on market demand and other agro-inputs to optimize input value chains to better serve smallholder farmers** | 47,06,922 94,138 4,70,692
| **Outcome 4.2: Intentional scaling out seed technologies through business plans at the national level** | 490,86,470 9,81,729 49,08,647
| **Outcome 4.3: Commercial hybrid seed production for DCLAS crops to support a vibrant seed sector in the drylands** | 168,10,435 3,36,209 16,81,043
| Outcome 4.4: Access to production inputs through credit and contracts so farmers are able to increase productivity and profitability | The need and enabling environment for microcredit, crop insurance and related options evaluated for all target countries, and location-specific optimal roadmaps developed. | Collaborative mini-pilots across at least three target countries establish demand, opportunities and feasibility for microfinancing and crop insurance. | Increased reach of microfinancing and crop insurance services to at least 50,000 farmers across target countries and regions where both need and infrastructure come together. | At least 75,000 farmers across target countries supported by credit and insurance services in collaboration with other agricultural commodity services in the target countries. | Microfinancing and crop insurance available for at least 100,000 farmers across all target countries leading to risk mitigation, improved whole-farm productivity and livelihood improvement. | Microfinancing and crop insurance available for at least 500,000 farmers across all target countries leading to risk mitigation, improved whole-farm productivity and livelihood improvement. | MEL Platform - Open Access | 78,64,848 | 1,57,297 | 7,86,485 |

| Flagship 5: Integrated Land, Water and Crop Management | Synthesized information available, and required interventions identified across all target countries on existing water, land allocation and conservation practices in collaboration with WLE. | At least one country with critical need and most ideal enabling environment pilot tested with farm-level interventions on optimal soil and water conservation practices. | Upscaling of farm-level interventions to community level in the pilot location reaching at least 25% farmsteads. | Community level interventions on water and soil conservation lead to diversified agricultural production opportunities and associated income for participating farmsteads. | Community level interventions upscaled to landscape level in collaboration with WLE to benefit more than 250,000 farmers. | Land and water conservation interventions adopted and/or benefited by 1000,000 farmers. | MEL Platform - Open Access | 1914,50,099 | 38,29,002 | 231,45,010 |

| Outcome 5.1: Water, land allocation and conservation to maximize sustainable profitability for smallholder farmers | Synthesized information on prevailing soil-crop-water-nutrient management options, regional facilities for soil-nutrient analysis, and enabling environment define clear road maps for all target countries. | Pilots implemented with tailored management practices for multiple communities within the chosen target countries. | Result- and learning-based optimization of pilot studies and re-evaluation for cost-efficient implementation. | Community-based pilots upscaled in collaboration with enabling partners and tested for effectiveness. | Policy interventions for proven sustainable land management options lead to large-scale adoption at the country level. | Land degradation halted/reduced across agricultural lands in the target regions of country(ies), with accompanying stable land productivity. | MEL Platform - Open Access | 250,43,441 | 5,00,869 | 25,04,344 |

| Outcome 5.2: Sustainable land mgmt. restoration and C sequestration that reverse land degradation | Road maps developed with national partners of selected priority country(ies) based on analyses of existing land degradation rates, possible interventions and enabling environments. | Implementations of developed road maps across all countries in pilot mode with national partners and enabling entities. | Confirmation of optimal integrated management practices, and their cost-efficient benefits to productivity enhancements from all target countries. | Upscaling of proven integrated management practices in consultation and collaboration with local governing and regulatory entities leading to adoption by at least 10% of farming communities in target countries. | Integrated management practices adopted by 1,000,000 farmers across all target countries. | Integrated management practices adopted by 1,500,000 farmers across all target countries, resulting in cost-efficient productivity increases and profits. | MEL Platform - Open Access | 313,04,301 | 6,26,086 | 31,30,430 |

| Outcome 5.3: Integrated soil-crop-water-nutrient management leading to best management practices | Synthesized information on prevailing soil-crop-water-nutrient management options, regional facilities for soil-nutrient analysis, and enabling environment define clear road maps for all target countries. | Implementation of developed road maps across all countries in pilot mode with national partners and enabling entities. | Confirmation of optimal integrated management practices, and their cost-efficient benefits to productivity enhancements from all target countries. | Upscaling of proven integrated management practices in consultation and collaboration with local governing and regulatory entities leading to adoption by at least 10% of farming communities in target countries. | Integrated management practices adopted by 1,000,000 farmers across all target countries. | Integrated management practices adopted by 1,500,000 farmers across all target countries, resulting in cost-efficient productivity increases and profits. | MEL Platform - Open Access | 328,69,516 | 6,57,390 | 32,86,952 |

<p>| Outcome 5.4: Cropping pattern, sequence and management to maximize farm profitability, manage risk and optimize resources (land, labor, inputs) | Analyses of existing cropping pattern, sequence and management practices, cost-benefit ratios, local preferences, and enabling environments leading to defined roadmaps for the implementation of optimal solutions. | Pilot evaluation of defined and tailored roadmaps across all target countries with accompanying information on crop productivity as well as optimal land use. | Confirmation of pilot performance along with its fit to local preferences, and required modifications built into upscaling plans. | Modified pilot projects upscaled to defined limits in all countries in consultation with local governing and implementation entities. | Optimal cropping pattern, sequence and management adopted by 10% of the total agricultural population of the target regions, and benefits to production, income, and soil improvements demonstrated. | Improved and efficient cropping pattern and sequence adopted together with optimal management practices by 1,000,000 farmers across all target countries with resulting benefits to livelihood (income) and land use. | MEL Platform - Open Access | 317,98,164 | 6,35,963 | 31,79,816 |</p>
<table>
<thead>
<tr>
<th>Flagship 6: Improved Rural Livelihood Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Outcome 5.5:</strong> Mechanization of farm operations to increase farm profitability and economic opportunity for women and youth through contracted services</td>
</tr>
<tr>
<td>Need, cost-benefit, enabling environment, and partnership analysis delivered for mechanization options across all target countries</td>
</tr>
<tr>
<td>Need-based mechanization processes developed or imported as required across pilot sites in at least half of the target countries; Redirection of time-savings to supplementary income-generation options explored with partners</td>
</tr>
<tr>
<td>Cooperative use or credit facilities arranged for mechanization options established for community level shared use across successful pilot locations</td>
</tr>
<tr>
<td>Successful interventions on cooperative use or credit facilities for mechanization expanded to all locations where there is demand</td>
</tr>
<tr>
<td>Improved farm productivity and alternative income generation for 1,000,000 farmers across all production regions</td>
</tr>
<tr>
<td>Improved farm productivity and alternative income generation for 2,000,000 farmers across all production regions</td>
</tr>
<tr>
<td>MEL Platform - Open Access</td>
</tr>
<tr>
<td>313,04,301</td>
</tr>
<tr>
<td>6,26,086</td>
</tr>
<tr>
<td>71,30,430</td>
</tr>
</tbody>
</table>

| **Outcome 5.6:** Sustainable management of biotic stresses through IPM that reduce environmental contamination and reduce human exposure to pesticides  |
| Existing and novel biological options and need for IPM solutions evaluated, enabling environment assessed, and partners engaged for defining a five-year plan for pilot testing and upscaling  |
| Proof of concept for novel IPM solutions for superior pest control and productivity increases, and reduced health and environmental hazards.  |
| Confirmation of proof of concept for novel IPM solutions across initial locations and extension across multiple locations.  |
| Adoption of proven safe and efficient IPM solutions by at least 20% of farmers in pilot testing locations.  |
| Safe and efficient IPM solutions adopted by all farmers in the testing locations and extended to newer locations  |
| Increased productivity and reduced pesticide residue on all farms across the locations where implemented  |
| 391,30,376  |
| 7,82,608  |
| 39,13,038  |

| **Outcome 6.1:** System-specific ex-ante analyses and prioritization to optimize impact pathways  |
| Information on existing models; need for updating: data sources, content and quality; infrastructure needs and expenses for data warehousing and cloud computing  |
| Testing of existing models in collaboration with FP1 and IPM across locations of the target countries for which base data are sound and sufficient  |
| Gap filling of required data for robust models on livelihood analysis and implementation of infrastructure of data warehousing, open access and cloud computing  |
| Road map for efficient, accurate and continuous updating, sharing and utilization of data developed; synthesis of current and foresight information used for at least one national or regional policy decision  |
| Continuous updating and analysis of models and data feeding into national or regional policy decisions  |
| Continuous updating and analysis of models and data feeding into national or regional policy decisions  |
| MEL Platform - Open Access  |
| 134,88,882  |
| 2,69,778  |
| 13,48,888  |

| **Outcome 6.2:** Testing, adaptation and validation of options through innovation platforms to manage risk, optimize market opportunities and promote on-farm biodiversity  |
| Model interventions identified for optimal resource use and livelihood improvements, necessary infrastructure, implementation capabilities, partnerships and enabling environment ensured  |
| Pilot mode on-ground testing of tailored location-specific model interventions at farm levels across all target countries  |
| Confirmation of pilot mode testing and model adjustment as necessary at farm level across all target countries  |
| Confirmed pilot-mode interventions upscaled to community level in all target countries and regions  |
| Onfarm productivity and livelihood improvement (yield, income, consumption of nutritious food) demonstrated for 1,000,000 small holder farmers  |
| Onfarm productivity and livelihood improvement (yield, income, consumption of nutritious food) demonstrated for 1,500,000 total small holder farmers  |
| MEL Platform - Open Access  |
| 299,75,294  |
| 5,99,506  |
| 29,97,529  |

| **Outcome 6.3:** Landscape management that generate incentives for community- and farmer-based management of natural resources  |
| Sustainable land management practices adopted over 250,000 ha across the target countries and regions  |
| Sustainable land management practices adopted over 500,000 ha across the target countries and regions  |
| Sustainable land management practices adopted over 750,000 ha across the target countries and regions  |
| Sustainable land management practices adopted over 1,000,000 ha across the target countries and regions  |
| Sustainable land management practices adopted over 1,500,000 ha across the target countries and regions  |
| Sustainable land management practices adopted over 2,000,000 ha across the target countries and regions  |
| MEL Platform - Open Access  |
| 149,87,647  |
| 2,99,753  |
| 14,98,765  |
| Outcome 6.4: Enabling policy environments for farmers to benefit from ecosystem services that drive improved stewardship of natural resources including biodiversity | Data assembled on existing scenarios and potential intervention points and opportunities, enabling environments. Roadmaps developed and confirmed with partners, infrastructure and capabilities for implementation ensured | Benefits from maintained ecosystem services are derived by at least 500,000 people | Benefits from maintained ecosystem services are derived by at least 750,000 people | Benefits from maintained ecosystem services are derived by at least 1,000,000 people | Benefits from maintained ecosystem services are derived by at least 1,500,000 people | Benefits from maintained ecosystem services are derived by at least 2,000,000 people | MEL Platform - Open Access | 134,88,882 | 2,69,778 | 13,48,888 |
|---|---|---|---|---|---|---|---|---|
| Outcome 6.5: Institutions are strengthened to generate pro-poor policies and economic incentives for broad-based economic development | Evaluation of existing data and roadmaps, infrastructure and capabilities ensured to implement economic development opportunities in collaboration with FP7 | Policy interventions and implementation of scalable farm-based income generation opportunities are available to 100,000 people across the target countries | Proven, scalable farm-based income generation opportunities are available to 250,000 people across the target countries | Proven, scalable farm-based income generation opportunities are available to 500,000 people across the target countries | Proven, scalable farm-based income generation opportunities are available to 1,000,000 people across the target countries | Proven, scalable farm-based income generation opportunities are available to 1,500,000 people across the target countries | MEL Platform - Open Access | 224,81,470 | 4,49,629 | 22,48,147 |
| Flagship 7: Post-harvest Value Addition and Output Markets | | | | | | | | 666,80,210 | 13,33,604 | 66,68,021 |
| Outcome 7.1: Human-centered development of processing technologies and knowledge that empower women and youth to add value and generate economic opportunity for local economies | Processing technologies developed for nutrition conservation, reduced losses and efficient operations | Processing technologies upscaled to benefit women and youth for income generation, and increased food and nutrition availability | Optimal processing technologies based on the cropping and farming systems of our target ecologies provide nutritional benefit for 500,000 women and children | Optimal processing technologies based on the cropping and farming systems of our target ecologies provide nutritional benefit for 1,000,000 women and children | Optimal processing technologies based on the cropping and farming systems of our target ecologies provide nutritional benefit for 1,500,000 women and children | Optimal processing technologies based on the cropping and farming systems of our target ecologies provide nutritional benefit for 2,000,000 women and children | MEL Platform - Open Access | 483,77,712 | 9,67,554 | 48,37,771 |
| Outcome 7.2: Reduce market barriers and increase profitability through equitable and transparent markets enabled through ICT, farmers organizations and enabling policies | Enabling environment created in collaboration with national partners and policy makers for reduced market barriers and the use of existing and innovative facilities for improved marketing opportunities | Farm-based income generation or improvement for 500,000 people in the target countries through targeted interventions | Farm-based income generation or improvement for 750,000 people in the target countries through targeted interventions | Farm-based income generation or improvement for 1,000,000 people in the target countries through targeted interventions | Farm-based income generation or improvement for 1,500,000 people in the target countries through targeted interventions | Farm-based income generation or improvement for 2,000,000 people in the target countries through targeted interventions | MEL Platform - Open Access | 183,02,498 | 3,66,050 | 18,30,250 |

273