

GLDC

Plan of Work and Budget 2019



RESEARCH PROGRAM ON Grain Legumes and Dryland Cereals



CGIAR Research Program on Grain Legumes and Dryland Cereals

The CGIAR Research Program on Grain Legumes and Dryland Cereals (GLDC) is an international consortium led by the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and CGIAR implementing partners including the International Institute for Tropical Agriculture (IITA), International Center for Agricultural Research in the Dry Areas (ICARDA), World Agroforestry Centre (ICRAF), International Livestock Research Institute (ILRI), International Water Management Institute (IWMI), and Bioversity International. In addition to the CGIAR, GLDC is implemented by IRD and CIRAD from France and CSIRO from Australia, besides various NGOs, NARS, and private sector partners. This consortium strives to support beneficiaries in 13 priority countries in South Asia and sub-Saharan Africa with a mission of delivering improved rural livelihoods and nutrition by prioritizing demand-driven innovation to increase production and market opportunities along value chains.

<http://gldc.cgiar.org>

Lead Center: International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)

Flagship Program 1: Priority Setting & Impact Acceleration

CGIAR Center: International Institute of Tropical Agriculture (IITA)

Flagship Program 2: Transforming Agri-food Systems*

Partner: Commonwealth Scientific and Industrial Research Organisation (CSIRO)

Flagship Program 3: Integrated Farm and Household Management

CGIAR Center: World Agroforestry Centre (ICRAF)

Flagship Program 4: Variety and Hybrid Development

CGIAR Center: International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)

Flagship Program 5: Pre-breeding and Trait Discovery

CGIAR Center: International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)

Other participating institutions: Institut de recherche pour le développement (IRD), Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD), International Center for Agricultural Research in the Dry Areas (ICARDA), Bioversity International, International Livestock Research Institute (ILRI), and International Water Management Institute (IWMI).

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*The Flagship Program 2 on Transforming Agri-food systems remains unfunded: however, starting 2019, key activities planned under this Flagship will be implemented through a new cross-cutting theme on Markets and Partnerships in Agri-Business (MPAB).

Acronyms and abbreviations

AGRA	Alliance for a Green Revolution in Africa
AVISA	Accelerated varietal improvement and seed delivery of legumes and cereals in Africa
BGM	Botrytis Grey Mould
BMGF	Bill & Melinda Gates Foundation
CERASS	Centre d'Etude Régional pour l'Amélioration de l'Adaptation à la Sécheresse
CIRAD	Centre de Coopération Internationale en Recherche Agronomique pour le Développement
CNGs	Crop Network Groups
CoPs	Community of Practices
CORAF/WECARD	Conseil Ouest et Centre Africain pour la Recherche et le Développement Agricoles
CRP-GLDC	CGIAR Research Program on Grain Legumes and Dryland Cereals
CRP-PIM	CGIAR Research Program on policies, Institutions and Markets
CRP-RTB	CGIAR Research Program on Roots, Tubers and Bananas
CRP-WLE	CGIAR Research Program on Water, Land and Ecosystems
CSIRO	Commonwealth Scientific and Industrial Research Organisation
EiB	Excellence in Breeding
ESA	Eastern and Southern Africa
FP	Flagship Program
GS	genomic selection
IAC	Independent Advisory Committee
IBP	Integrated Breeding Platform
ICARDA	International Center for Agricultural Research in the Dry Areas
ICRAF	World Agroforestry Centre
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IISD	Integrated Seed Systems Development
IITA	International Institute for Tropical Agriculture
ILRI	International Livestock Research Institute
IWMI	International Water Management Institute
IRD	Institut de recherche pour le développement
MISST	Malawi Improved Seed Systems and Technologies
MPAB	Markets and Partnerships in Agri-Business
NARS	national agricultural research system
NGOs	non-governmental organizations
PPs	product profiles
QC	quality control
QTLs	quantitative trait loci
RGA	rapid generation advancement
RGT	rapid generation turnover
SA	South Asia
SI	Sustainable intensification
SLU	Swedish University of Agricultural Sciences
SNP	Single Nucleotide Polymorphism
SRF	Strategy and Results Framework
SSA	sub-Saharan Africa
ToC	Theory of Change
TPE	Target population of environments
USAID	United States Agency for International Development

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1. Adjustments/Changes to Theories of Change (ToC)

The demand for dryland cereals and grain legumes suggests the need to increase production and market opportunities for the future. Among the barriers to doing so are the non-adoption of improved germplasm, agricultural practices not adapted to climate change, consumers' restrictive diet options, weak value chains, market failures, regulatory constraints, and twisted agricultural and trade policies. Addressing these unresolved and poorly understood barriers in isolation, however, underestimates their interconnectedness in the drylands of sub-Saharan Africa (SSA) and South Asia (SA). The Theory of Change (ToC), therefore, was based on the integration services under FP2 (Transforming Agri-food Systems). However, this flagship was not supported under the current GLDC.

This led GLDC's senior management and research partners to design a cross-cutting theme: Markets and Partnerships in Agri-Business (MPAB). Under the theme, researchers work with partners in a specific country and value chain contexts to unlock market opportunities for GLDC. The initial anchoring of GLDC in institutional theories (to understand social values, rules, norms, traditions and human practices) will be secured through FP1, if sufficient funding is available.

Despite the introduction of MPAB as a cross-cutting theme, the overall ToC remains unchanged. As planned, the GLDC consortium will increase protein availability from legumes and reduce the risk of hunger by diversifying crops and their duration. Research questions around accessibility and utilization of improved crops are addressed to a limited extent under FP1. Further, GLDC will contribute to the Strategy and Results Framework (SRF) through two distinct impact pathways ('integrative solutions' and 'scaling and sustaining'). Neither these pathways nor gender and capacity development approaches are affected by the structural changes. Youth and gender remain critical as impact accelerators.

FP3 undertook an in-depth review during the first year of implementation (2018) through virtual and face-to-face meetings. COA 3.1 and 3.2 have been inverted and activities clustered in 7 main areas of work.

2. Plans and Expected Progress Towards Outcomes

Flagship Program 1: Priority Setting & Impact Acceleration

Building on the foresight and ex-ante impact analyses of the potential economic and poverty reduction impacts of GLDC research and technology options, FP1 will conduct an ex-ante evaluation of potential nutrition security impacts of its research and technology options. This will guide further prioritization to sharpen its research for increased uptake and impacts of GLDC technologies and innovations. The priority assessment work will benefit from datasets that will be developed for future climate scenarios for GLDC mega environments in SSA and SA. The work on value chains, markets, and drivers of adoption will identify market and household demands and assess trade-offs for more inclusive value chains that improve income and nutrition status in the target regions. The demands are expected to shape the uptake and market potential of agricultural technologies and production. Clarity on the fundamental drivers of the demands disaggregated by gender and age (i.e. youth and others) will give insights into the levers of change to scale-up initiatives. Their demand will be assessed as producers and consumers of GLDC-related technologies and practices. These drivers of demand are directly actionable within the other FPs and for breeding product profiles to generate new technologies and practices that better target the demands and needs of households in the target regions and beyond. This work will enable GLDC improve efficiencies and generate greater impact using more efficient approaches in communicating for scaling.

In 2019, following up on the in-depth review of literature on youth in the drylands, work will involve specific case studies in Uganda, Ethiopia, and Tanzania to pilot test the ToC and offer recommendations for youth engagement in GLDC. Studies on opportunities for and constraints to enhancing gender equity in the production and marketing of GLDC crops and understanding the effects of asset ownership and rural

migration on gender relations in smallholder systems will continue. This will aid integration, inclusion and equity among women and youth beneficiaries and stakeholders to strengthen the relevance and targeting of research outputs and enhance development impacts. To support technology development and adoption, FP1 will conclude the evaluation and synthesis of GLDC scaling approaches and associated adoption and impact evidence to document lessons from key GLDC scaling projects. New GLDC projects are expected to adopt key scaling recommendations following an assessment of scaling approaches. Gender research issues have also been integrated, for instance, into the work on value chains and markets, whereas the work on gender and youth itself addresses overarching gender research questions. FP1 will also develop an integrated and multi-faceted impact assessment and learning strategy to stimulate investment and to undertake a portfolio of high-quality outcome and impact studies.

Flagship Program 2: Transforming Agri-food Systems

Since FP2 was not funded, its activities are being carried out under the Bilateral projects. However, some critical activities that have an impact on other FPs are being planned under a cross-cutting theme on Markets and Partnerships in Agri-Business (MBAP), with funds contributed by the respective Flagship Programs on a pro-rata basis.

Flagship Program 3: Integrated Farm and Household Management

Under FP3, the CoAs 3.1, 3.2 and 3.3 have been clustered into seven areas of work. **CoA 3.1 (Innovations for managing abiotic and biotic stresses)** has re-oriented its activity portfolio into two clusters, abiotic and biotic stresses. Under abiotic stresses, activities will focus around plant growth promoting microorganisms (novel approaches to characterize soil microbiome diversity at the discovery level) and using the most appropriate mycorrhizal isolates to restore soil health in different cropping systems (at the implementation level). The second set of activities will assess drivers for cropping system optimization, e.g. under different climate change scenarios, involving the assessment of cereal-legume combinations under low-input systems and measuring possible component traits contributing to the adaptation to intercropping. Organic fertilizer recommendations will be validated at landscape level, coupled with integrated technical and socio-economic analysis of fertility management options. Under biotic stresses, activities have been regrouped under three sets, where the first set involves monitoring of emerging diseases, diagnostics and virulence spectrum with activities targeting important emerging bio-risks such as the fall armyworm, sorghum lethal necrosis and Phytophthora blight. The second one involves testing and deploying pest and disease control options (biological and chemical) targeting the release of biological control agents against the cowpea pod borer, and an assessment of natural enemies against the fall armyworm on sorghum, and millet head borer, while on the discovery side, investigations will involve novel bio-pesticidal compounds targeting a range of plant pathogens. The third set will focus on discovering new sources of host-plant resistance against key emerging pests and diseases that can be utilized by the breeders under FP4.

CoA 3.2 (Cropping systems management) has two main activities. The first on production systems will evaluate cropping systems through farmer participatory trials under smallholder conditions and integrate new legume germplasm and improved production technologies across ecologies to sustainably improve productivity, intensification and diversification of cereal-based systems. Major traits of interest in the legumes germplasm include drought tolerance, high grain yielding, and high biomass production with high nitrogen fixation ability. The best system intensification and crop diversification options will also be tested in combination with crop and soil management techniques designed to improve water use efficiency under dryland conditions. Another activity such as the decision support tools component, will together with the production system component, characterize household typologies using multivariate statistics and participatory appraisals for common and type-specific determinants of adoption of innovations, intensification and diversification options. Ex-post impacts of innovation practices including cereal-legume intercropping, use of improved seeds together with fertilizer and other inputs on crop production efficiency and household livelihoods will be measured. CoA 3.1 will capitalize on complementary agricultural system

simulation models (crop system simulation model, agent-based model, nutrient balance/flow models, bio-economic model) to generate information and identify best-fit options for extension agents and farmers to optimize crop and total farm productivity, and resource use efficiencies in convergence with CoA 3.3.

CoA 3.3 (Testing, adapting and validating options) aims to develop, test, and validate options for sustainable intensification and livelihood diversification, with the following three groups of activities: **Impact assessment across scales and dimensions in relation to farm households** that will focus on ex-ante and ex-post impact assessments across spatial and temporal scales and sustainability domains (e.g. farm productivity, economic outcome, human well-being, environmental and social outcomes), for which relevant criteria and indicators are being determined. This site-specific exercise will also work towards developing a common framework of principles, criteria and indicators applicable across sites and farming systems. Selected GLDC innovations and sustainable intensification (SI) options are being evaluated based on criteria and indicators in various sustainability domains. Activities on **Evaluating trade-offs and co-designing farming systems for enhanced resilience and income** brings together modelling approaches (many developed and/or verified in CoA 3.1) to evaluate tradeoffs across domains and across spatial and temporal scales, integrating household- and landscape-level approaches. The modelling tools will be compared, improved and tested, and used in participatory settings to co-design improved farming systems. A third set of activities, **Information and knowledge for targeting gender and nutrition under GLDC farming systems**, will synthesize knowledge and information to target gender and nutrition in the development of GLDC options. This links to other groups of activities such as gender and nutrition-related criteria and indicators that are being developed and integrated in the assessment frameworks. The activity group will (i) assess the role of gender within and across livelihood contexts, (ii) examine the potential effect of gender-based constraints and benefits on the adoption of proposed technology packages, and (iii) assess the benefits of engendering a decision support tool to evaluate performance of legume technologies across a range of agro-ecologies and socio-economic conditions.

Flagship Program 4: Variety and Hybrid Development

Crop Network Groups (CNGs) constituted by the CGIAR, the national agricultural research system (NARS), private sector, NGOs, research institutes, etc, is a multi-stakeholder platform engaged in designing, developing, testing, advancing, and delivering product profiles (PPs) for GLDC's crop commodities in target ecologies of SSA and SA. During 2019, the CNGs and the Excellence in Breeding (EiB) platform will design PPs for crop x regions, sharing of crop breeding lines, and conducting multi-location testing by adopting standard testing designs and protocols. The Community of Practices (CoPs) of CNGs on the Integrated Breeding Platform (IBP) facilitates continuous engagement among CNG members. Partnerships with the Alliance for a Green Revolution in Africa (AGRA), Syngenta Foundation, Advanta Seed Co., the United States Agency for International Development (USAID) crop innovation labs, CIRAD, Conseil Ouest et Centre Africain pour la Recherche et le Développement Agricoles (CORAF/WECARD), Centre d'Etude Régional pour l'Amélioration de l'Adaptation à la Sécheresse (CERASS) and NARS testing networks, among others, will be critical to further CNGs in SSA and SA. Through these multi-stakeholder platforms, product advancement criteria and processes to prioritize varieties for commercialization will be established and standardized. Public and private sectors will be engaged in innovative ways to enhance supply of and access to high quality seed of improved varieties.

Towards modernizing the CGIAR's crop breeding programs, the FP4 team has prioritized a seed inventory system for transparent handling of crop breeding seed material, quality control (QC) tools to safeguard genetic purity and deploying high throughput phenotyping for grain and fodder quality. The available rapid generation turnover (RGT) tools will be deployed in chickpea, pigeonpea, lentil, groundnut, sorghum and millet breeding pipelines to reduce the cycle time and thus achieve enhanced rate of genetic gain per unit cost. Selection adjustments will be made to enhance genetic gain in all the target traits including nutritional quality traits such as high iron (Fe) and zinc (Zn) sorghum, pearl millet and lentil, besides the development of varieties of crop such as sorghum for the brewing industry in ESA, finger millet for value addition in India and Ethiopia, and high oleic groundnut for food processing industries to meet emerging markets. Genomic

selection (GS) in pearl millet and Single Nucleotide Polymorphism (SNP) genotyping for early generation selection in breeding pipelines of GLDC crops will be deployed in breeding pipelines. A capacity building program targeting ‘practicing plant breeders’ focusing on knowledge gaps will enable NARS crop breeding teams to implement effective and cost-efficient breeding programs. Nursery management will be strengthened to support the early generation, and seed made available to NARS for evaluations.

Aimed at modernizing crop breeding, multi-disciplinary teams will be involved in the entire process from product profile design to delivery by aligning to a ‘stage-gate’ system. Release of new resilient crop varieties with enhanced nutritional qualities in target ecologies in partnership with private seed companies and not-for-profit organizations like Syngenta Foundation will generate novel ways of partnership engagement along stage-gates.

Flagship Program 5: Pre-breeding and Trait Discovery

In 2019, FP5 will focus on trait discovery, functional validation of traits, and pre-breeding by exploiting natural and/or systematically induced variations for prioritized traits in combination with modern genomics, transgenics, phenomics, and breeding tools for accelerated, precise, cost-effective, and efficient breeding of new varieties in future.

CoA 5.1 (Pre-breeding) will focus on advancing prioritized traits for pre-breeding through ongoing activities on exploring the natural diversity in wild/un-adapted germplasm, such as those related to Botrytis grey mould (BGM) in chickpea and blast/heat tolerance in pearl millet by using the wild germplasm in ongoing activities that are also partially supported by bilateral projects. The focus will also be on the characterization and advancement of already created transgenic events for traits (such as Bt) where natural diversity is not available. **CoA 5.2 (Trait discovery)** will focus on mapping and dissection of at least one top priority trait in each target crop. In 2019, major focus areas will be marker development, validation, and deployment for at least one priority trait in two GLDC crops and the development and validation of genomic selection (GS) in two GLDC mandate crops. Advancing the introgression (molecular breeding) lines in one cereal and one legume harboring the quantitative trait loci (QTLs)/genomic regions controlling desired traits in elite lines will be the focus. **CoA 5.3 (Enabling technologies)** will continue to focus on standardizing protocols, establishing and proof of concept in genome editing, second generation transformation (QuickCrop from Corteva Agriscience), systematic mutant populations, and rapid generation advancement (RGA) in at least two GLDC crops for which expertise and learnings from private partners (Corteva Agriscience) will be leveraged. Refinement of genome assembly in at least one legume will be achieved using Hi-C approach in collaboration with a leading group expert in this area in USA. FP5 will continue capacity development of students and researchers (especially of NARS partners), organizing training courses, seminars, workshops, symposia, supporting exchange visits, data management, etc. The knowledge generated from FP5 will be applied (through FP4) in crop improvement and be disseminated in the form of reports, datasets, scientific publications, and presentations at various scientific fora.

Cross-Cutting Dimensions

Capacity Development

Capacity development is central to GLDC. FPs 1, 3, 4 and 5 will implement different types of multi-stakeholder innovation platforms. Many activities will focus on supporting the growth of future research leaders through MSc and PhD programs, scholarships, and exchange programs. NARS scientists are another important target group. In addition, farmers will be trained, especially youth and women. FP3 will roll out a training program to reach end users at scale. The process of developing an E-learning platform for NARS scientists and development agents to improve their access to training materials such as manuals, presentations, and videos, etc, and learn innovative approaches, will continue.

Gender & Youth

We conceptualize that developing and realizing aspirations among the youth is a function of capital (human, social, physical), gender and the cultural gendered opportunities offered, disruptors that are gendered, policy and market opportunities that the youth are exposed to; their lived experiences and factors that enable pursuit of those aspirations.

In 2019, GLDC will be refining its ToC on youth targets and recommend interventions for the youth in the drylands of Ethiopia, Tanzania, Uganda, and Mali. The findings of the assessments of the impacts of rural migration on rural production and decision-making done in select countries in 2018 will be tested in interventions that enhance gender equality and empowerment in value chains.

In 2019, social and behavior change communication tailored to improve seed utilization will be piloted among rural women and smallholder communities. Nutrition packages encompassing high value GLDC crops will be targeted at youth, especially young malnourished and stunted women. Methodologies to integrate gender and breeding methods and data for assessing breeding product profiles and consumer profiles were designed and tested in 2018 in consultation with the Gender and Breeding initiative of the CGIAR. These tools will be piloted in the GLDC product profile development process.

Gender capacity development of partners through internship programs for young MSc and PhD scholars will continue into 2019. Enhancing gender research design, analysis, and reporting capacities and contribution to gender-responsive product profiles is also prioritized for 2019.

New cross-cutting theme on Markets and Partnerships on Agri-Business (MPAB)

Since FP2 on Transforming Agri-food Systems remains unfunded, some of its important activities are being planned as a new cross-cutting theme on Markets and Partnerships on Agri-Business (MPAB). This theme aims to achieve a science agenda that explores innovation in GLDC agri-food systems. It will act as a focal point for activities related to market demand and the development of market demand for GLDC crops. It is expected to facilitate the development of new partnerships with market actors and those engaged in the development of market opportunities for GLDC crops. This will provide services to the other FPs with market and agri-food system expertise, with a focus on working with partners and stakeholders in specific country and value chain contexts. MPAB will explore a key research question: what suites of interventions would be effective in developing market opportunities for GLDC crops, creating incentives for the adoption of new GLDC varieties, and delivering poverty reduction and nutritional security benefits? This will be explored through an agri-food systems perspective that includes governance and political economy aspects within its analysis.

Table 2A: Planned Milestones by Flagship

FP	Mapped to Sub-IDO	2022 FP Outcomes	Milestone	Source	Means of Verification	Gender Marker 1	Youth Marker 1	CapDev Marker 1	Climate Change Marker 1	Assessment of Risk to achieve that Milestone	For medium/high please select the main risk from the list
1	Increased resilience of agro-ecosystems and communities, especially those including smallholders	Outcome 1. Improved targeting and responsiveness of research to market and household demands in the face of climate change for greater technology adoption, food and nutrition security, resilience, and poverty reduction	Ex-ante evaluation of GLDC research and technology options completed and working papers published on the potential poverty and nutrition security impacts to guide priority setting	Reworded/rephrased from proposal	Foresight and ex-ante evaluation working papers and the final results that will be shared with GLDC researchers and stakeholders at the annual review and planning meeting	0	0	0	1	Low	
1	Increased livelihood opportunities	Outcome 2. Market and household demand identified and trade-offs assessed for more inclusive value chains that	Shared learning across GLDC stakeholders and FPs on implications of diverse targets aspirations and future scenarios	Identical to proposal	Report on diversity of target group preferences and match and mismatch of GLDC research targets based on meetings and workshops across GLDC	1	1	1	0	Low	

FP	Mapped to Sub-IDO	2022 FP Outcomes	Milestone	Source	Means of Verification	Gender Marker 1	Youth Marker 1	CapDev Marker 1	Climate Change Marker 1	Assessment of Risk to achieve that Milestone	For medium/high please select the main risk from the list
		improve income and nutrition status in target regions	leading to strategic adjustments								
1	Improved capacity of women and young people to participate in decision-making	Outcome 3. Inclusive and equitable technologies and innovation systems established for accelerated and broadened impact across the agri-food system	Inclusive and equitable innovation system tested and adjusted to different biophysical and socioeconomic contexts including policy interactions	Identical to proposal	Reports on performance of innovation systems for women and youth in different contexts including recommendations for enabling environments synthesis report [paper] on improved capacities and skills for women and youth	2	1	1	0	Medium	External environment (political, economic, legal, market) - e.g. risk of non-delivery due to conflict, economic/ market changes
1	Conducive agricultural policy environment	Outcome 4. Strong project design, execution, monitoring and evaluation systems and tools consistently applied in GLDC scaling projects,	Evaluation documenting the strengths, shortcomings, and key lessons learn on GLDC scaling approaches and impacts	Identical to proposal	Evaluation report	1	1	1	1	Medium	Partnership - risk that partners won't be able to deliver a key task/deliverable on time

FP	Mapped to Sub-IDO	2022 FP Outcomes	Milestone	Source	Means of Verification	Gender Marker 1	Youth Marker 1	CapDev Marker 1	Climate Change Marker 1	Assessment of Risk to achieve that Milestone	For medium/high please select the main risk from the list
		with demonstrable progress on enhanced adoption and impact									
1	Conducive agricultural policy environment	Outcome 4. Strong project design, execution, monitoring and evaluation systems and tools consistently applied in GLDC scaling projects, with demonstrable progress on enhanced adoption and impact	Working strategy for evidencing the outcomes and impacts of GLDC	New/changed	Strategy	1	1	1	1	Medium	Internal resources - risk that key staff, infrastructure or equipment not available at time needed
3	Reduced production risk	FP3.O1. Pest and diseases controlled safely and with reduced agro-chemical inputs	Efficacy of, 1) selected pest and diseases management options, and 2) resource and soil management	Reworded/rephrased from proposal	Publication, Reports	1	1	1	1	Medium	Partnership - risk that partners won't be able to deliver a key task/deliverable on time

FP	Mapped to Sub-IDO	2022 FP Outcomes	Milestone	Source	Means of Verification	Gender Marker 1	Youth Marker 1	CapDev Marker 1	Climate Change Marker 1	Assessment of Risk to achieve that Milestone	For medium/high please select the main risk from the list
			options confirmed at pilot scale								
3	Increased resilience of agro-ecosystems and communities, especially those including small-holders	FP3.O2. Cropping systems sustainably intensified and diversified	Farm-household typologies characterized and participatory field trials under smallholder conditions in different cropping systems evaluated for common and type-specific determinants of adoption of innovations, intensification and diversification options	New/changed	a) Reports on participatory field trials and multivariate analysis; and b) publications	1	0	1	NA	Medium	Financial - funding not fully confirmed or at risk of being cut
3	Increased resilience of agro-ecosystems and communities, especially those including smallholders	FP3.O2. Cropping systems sustainably intensified and diversified	3,000 farmers are trained in the use of crop mixes and sequences jointly identified with researcher for better water and soil management	Reworded/rephrased from proposal	Research and evaluation reports, training manuals, fact sheets and other extension materials	1	1	2	NA	Medium	Financial - funding not fully confirmed or at risk of being cut

FP	Mapped to Sub-IDO	2022 FP Outcomes	Milestone	Source	Means of Verification	Gender Marker 1	Youth Marker 1	CapDev Marker 1	Climate Change Marker 1	Assessment of Risk to achieve that Milestone	For medium/high please select the main risk from the list
3	Increased resilience of agro-ecosystems and communities, especially those including smallholders	FP3.O2. Cropping systems sustainably intensified and diversified	Ex-post impacts of innovation practices on crop production efficiency and household livelihoods measured	New/changed	a) Reports on ex-post impact assessment with an efficiency focus; b) publications (submitted journal article, conference proceeding paper)	1	0	0	NA	Medium	Financial - funding not fully confirmed or at risk of being cut
3	Reduced production risk	FP3.O3. Tested, adapted and validated options applied for sustainable intensification and livelihood diversification by farmers	Suite of systems modelling tools/framework for co-designing resilient farming systems in GLDC regions	New/changed	Publication, Reports, technical document	0	1	2	1	Medium	Partnership - risk that partners won't be able to deliver a key task/deliverable on time
4	Enhanced genetic gains	FP4.O1. New varieties & allied innovations improving productivity & production potential, agribusiness opportunity & stabilize food supply	Initial analysis of stress patterns in target populations of environments (TPE) on few crops are available to better decide on breeding target	New/changed	Publication, Reports, technical document	0	0	2	1	Low	

FP	Mapped to Sub-IDO	2022 FP Outcomes	Milestone	Source	Means of Verification	Gender Marker 1	Youth Marker 1	CapDev Marker 1	Climate Change Marker 1	Assessment of Risk to achieve that Milestone	For medium/high please select the main risk from the list
4	Increased capacity for innovation in partner research organizations	FP4.O2. Robust and responsive global to national breeding systems produce and deliver novel varieties and allied innovations at appropriate scale and scope	Develop product profiles for crops × regions with NARS	New/changed		1	1	2	0	Low	
4	Enhanced genetic gains	FP4.O1. New varieties & allied innovations improving productivity & production potential, agribusiness opportunity & stabilize food supply	Phase I genetic materials deployed in GLDC crop improvement by CGIAR centers - annually 8 crops × 3 trait clusters × 2 regions tested by NARS	New/changed		1	1	1	0	Low	
4	Increased availability of diverse nutrient-rich foods	FP4.O1. New varieties & allied innovations improving productivity & production potential, agribusiness	New varieties with enhanced nutrient levels (Fe, Zn, oil, protein, high oleic) developed	New/changed	Publication, Reports, technical document	1	1	1	0	Low	

FP	Mapped to Sub-IDO	2022 FP Outcomes	Milestone	Source	Means of Verification	Gender Marker 1	Youth Marker 1	CapDev Marker 1	Climate Change Marker 1	Assessment of Risk to achieve that Milestone	For medium/high please select the main risk from the list
		opportunity & stabilize food supply									
4	Closed yield gaps through improved agronomic and animal husbandry practices	FP4.O1. New varieties & allied innovations improving productivity & production potential, agribusiness opportunity & stabilize food supply	New suite of resilient varieties released by NARS partners. (Phase 1 investments start being released)	Identical to proposal		1	0	1	0	Low	
5	Increased conservation and use of genetic resources	FP5.O1. Pre-breeding products through use of genebanks and other sources and modern tools to increase genetic diversity in breeding programs globally	Development/refinement of technologies for overcoming barriers to wide crosses for 1 crop	Identical to proposal	4 Publications/reports/technical bulletins	NA	NA	1	NA	Medium	Research/science - inherent risk in unknown cutting edge research or science
5	Enhanced genetic gains	FP5.O2. Trait discovery and development based on genomics and	Precision phenotyping for key traits for these collections and genotyping to	Identical to proposal	4 publications/reports and 1 databases	NA	NA	1	NA	Low	

FP	Mapped to Sub-IDO	2022 FP Outcomes	Milestone	Source	Means of Verification	Gender Marker 1	Youth Marker 1	CapDev Marker 1	Climate Change Marker 1	Assessment of Risk to achieve that Milestone	For medium/high please select the main risk from the list
		phenomics to generate new markers to support trait integration through use of modern enabling technologies and forward breeding	identify novel alleles for 2 traits in 2 crops that have limited variability in breeding populations								
5	Enhanced genetic gains	FP5.O2. Trait discovery and development based on genomics and phenomics to generate new markers to support trait integration through use of modern enabling technologies and forward breeding	Network of precision phenotyping sites is established across GLDC crops to provide unique and relevant testing locations for key traits (FP4.1). Gain-of-function or loss of function platform in 1 cereal and 2 legumes established	Identical to proposal	2 publications, and 2 fully functional databases. Transgenic platform for gain or loss of function in 3 crops	NA	NA	1	NA	Medium	Research/science - inherent risk in unknown cutting edge research or science

Table 2B: Planned Evaluations/ Reviews, Impact Assessments and Learning Exercises

CRP	FP (if not overall CRP)	Status (drop down menu: ongoing, new)	Planned studies/learning exercises in the coming year (examples only)	Geographic scope (specify country or region if relevant)	Who is commissioning this study
GLDC	FP1	Ongoing	Adoption and impacts of improved cowpea varieties in Nigeria (IITA)	Nigeria	IITA (Tropical Legumes III mapped project)
GLDC	FP1	Ongoing	Adoption and impacts of improved soybean varieties and agronomic practices in Malawi (IITA)	Malawi	IITA [Feed the Future 999999(MISST) mapped project]
GLDC	FP1	Ongoing	Impact assessment of N2Africa project	Ghana, Nigeria, Tanzania, Uganda	IITA [Putting Nitrogen Fixation to Work for Smallholder Farmers in Africa (N2Africa) Phase II (BMGF Grant No. OPP1020032) mapped project]
GLDC	FP1	Ongoing	Analysis of advantages and disadvantages of rice fallow vs rice legumes (ICARDA)	India	ICARDA
GLDC	FP1	Ongoing	Adoption and impacts of groundnuts in Tanzania and Nigeria	Tanzania and Nigeria	ICRISAT
GLDC	FP1	Ongoing	Adoption and impacts of chickpea in Ethiopia	Ethiopia	ICRISAT
GLDC	FP1	Ongoing	Uptake of improved varieties of cowpea and pigeonpea among households in the Drylands Development Program's (DryDev) catchment area	Kenya	ICRAF
GLDC	FP1	Ongoing	Uptake of improved varieties of sorghum and groundnut among households in DryDev's catchment area	Ethiopia	ICRAF

CRP	FP (if not overall CRP)	Status (drop down menu: ongoing, new)	Planned studies/learning exercises in the coming year (examples only)	Geographic scope (specify country or region if relevant)	Who is commissioning this study
GLDC	FP1	Ongoing	Uptake of improved varieties of sorghum, pearl millet, groundnut, cowpea, and soybean among households in DryDev's catchment area	Mali	ICRAF
GLDC	FP1	Ongoing	Uptake of improved varieties of pearl millet, groundnut, and cowpea in DryDev's catchment area	Niger	ICRAF
GLDC	FP1	Ongoing	Uptake of improved varieties of sorghum, pearl millet, groundnut, and cowpea among households in DryDev's catchment area	Burkina Faso	ICRAF
GLDC	FP1	New	Assess the potential nutrition security impacts of GLDC technologies in the drylands of SSA and South Asia	SSA and South Asia	IITA/ICRISAT/ICARDA
GLDC	FP1	New	Integrated and multi-faceted impact assessment and learning strategy for GLDC	Global	ICRAF
GLDC	FP3	New	Sustainability assessment of smallholder's farming system: assessment of the impacts of sustainable intensification (SI) options	Global	SLU/ICRISAT/WUR
GLDC	All	Ongoing	Identify a common set of performance indicators that all projects can report on at the CRP level beyond the CGIAR ones	Global	PMU
GLDC	All	Ongoing	Capacity development and Joint learning exercises	Global	PMU
GLDC	All	Ongoing	Ensure real time data visualization based on conceptualized indicator framework (MEASURE, MARLO, CLARISA)	Global	PMU

Table 2C: Major planned new collaborations (CGIAR Internal, or with non-CGIAR Collaborators)

FP	Name of CRP or non-CGIAR collaborator	Brief description of collaboration (give and take among CRPs/PTFs/non-CGIAR collaborator) and value added (e.g. scientific or efficiency benefits)
1.2	Bangor University, Cynefin Centre	The Cynefin Centre is an important collaborator of the activities in Cluster 1.2. Using the 'SenseMaker' tool developed by this partner as well as generating valuable co-funding through in-kind staff time contributions enables us to generate more outputs than the GLDC funding alone would be able to. The expertise around the new approach allows us to employ the innovative tool and add new angles of insights into our target population's behavior.
1.2	University of Hohenheim	Continue to work with one MSc student who is fulfilling her degree at the University of Hohenheim.
3.3	Swedish University of Agricultural Sciences (SLU)	Collaboration with the SLU team funded through Agriculture for Food Security (AgriFoSe) will develop a comprehensive and ready-to-use framework for sustainability assessment of smallholders' farming system.
3.3	International Livestock Research Institute (ILRI) and CRP on Policies, Institutions and Markets (PIM)	This partnership funded through CRP-PIM enables better integration of our farm household level analysis into livestock value chain analysis leading to a holistic assessment resulting in the development of multiple options for improving the crop-livestock economy in West Africa.
3.3	CRP on Roots, Tubers, and Bananas (RTB), CRP on MAIZE, CRP on Water, Land and Ecosystems (WLE)	Coordinate efforts on criteria and indicators for sustainable intensification assessment.
3.3	CRP on Policies, Institutions and Markets (PIM)	Better integration of our farm household level analysis into livestock value chain analysis leading to a holistic assessment resulting in the development of multiple options for improving the crop-livestock economy in West Africa.
4.1	Hiphen Ltd	Hiphen is now a well-established start-up in the domain of image signal treatment and analysis in support of the breeding industry. The added value comes in the connection of Hiphen with one of the world leading research groups on image signal treatment (F Baret, Institut national de la recherche agronomique-INRA Montpellier).

FP	Name of CRP or non-CGIAR collaborator	Brief description of collaboration (give and take among CRPs/PTFs/non-CGIAR collaborator) and value added (e.g. scientific or efficiency benefits)
4.4	Integrated Seed Sector Development (ISSD) Africa	Collaboration with the Africa-based community of practice of seed experts with whom knowledge and experiences about seed systems and seed value chains can be shared for wider impact.
4.4	Accelerated varietal improvement and seed delivery of legumes and cereals in Africa (AVISA)	This is a new multi-partner crop improvement and seed systems initiative bringing together 4 GLDC crops (sorghum, groundnut, pearl millet, and cowpea) through 2 CGIAR centers (ICRISAT and IITA) and NARS partners in 7 African countries (Nigeria, Mali, Burkina Faso, Ghana, Tanzania, Ethiopia and Uganda), supported by Syngenta Foundation and funded by the Bill & Melinda Gates Foundation (BMGF).
5.2	Rothamsted Research Station UK	An exchange visit of a student for 3 months from CINTRIN/INEW to study the localization of Zn/Fe in sorghum grains in normal and biofortified lines. In addition, the collaboration will study the effect of N levels on Zn/Fe accumulation.
5.3	Corteva Agriscience	To continue with the Master Alliance Agreement with Corteva Agriscience to access enabling tools and technologies. This collaboration started in mid-2018 (one student trained at Corteva Agriscience, USA) will continue to access the 2 nd generation transformation protocols and genome editing platforms for GLDC crops. This collaboration will also be extended to improve pearl millet in a consortium mode with ICRISAT-EiB-Corteva Agriscience.
Cross-Cutting (M&E)	CRP on Roots, Tubers, and Bananas (RTB), CRP on FISH, International Institute of Tropical Agriculture (IITA)	GLDC will actively cooperate with RTB and FISH in the use of the MEL platform. The tool used by the three CRPs ensures proper planning, monitoring, evaluation and learning activities. In 2019, the plan is to advance several integrations including the interoperability with MARLO in order to provide the System Office (CLARISA) a common set of harvestable elements. IITA plays a key role between RTB and GLDC since it is one of other Centers (CIP, ICARDA) adopting MEL at the institutional, level thus providing a different learning perspective.

3. Financial Plan for the coming year, including use of W1/2

The CRP-GLDC budget for 2019 is proposed at \$ 8.20M. FP2 on Transforming Agri-food Systems, which was a part of the approved CRP-GLDC, remains unfunded. However, for 2019, a total of \$ 6,098,000 has been mapped to the objectives of this flagship by ICRISAT. Hence, it is proposed that some of the important activities of FP2 are implemented as a new cross-cutting theme on Markets and Partnerships on Agri-business (MPAB). An amount of \$ 250,000 is proposed for the implementation of MPAB activities through pro-rata contributions by other FPs and budget line items. MPAB will service these flagships with market and agri-food system expertise, with a focus on working with partners and stakeholders in specific country and value chain contexts. MPAB will facilitate the development of partnerships with market actors and those engaged in the development of market opportunities for GLDC crops.

Table 3: Planned Budget

CRP-GLDC	Planned budget 2019 (\$)				Comments on major changes
	W1/2	W3/bilateral	Center Own fund	Total	
FP1	821,816	3,579,396	0	4,401,212	Spending W1/2 to 85% is represented by 1st and 2nd level priorities. Includes FP and CoA Co-Leaders salary and admin management contribution.
FP2	0	6,098,000	0	6,098,000	Though FP2 is not funded however the activities planned under this FP are being carried out from the W3/Bilateral projects.
FP3	1,599,581	17,911,332	0	19,510,913	Spending W1/2 to 85% is represented by 1st and 2nd level priorities. Includes FP and CoA Co-Leaders salary and admin management contribution.
FP4	2,519,612	13,732,945	0	16,252,557	Spending W1/2 to 85% is represented by 1st and 2nd level priorities. Includes FP and CoA Co-Leaders salary and admin management contribution.
FP5	1,154,882	10,012,582	0	11,167,464	Spending W1/2 to 85% is represented by 1st and 2nd level priorities. Includes FP and CoA Co-Leaders salary and admin management contribution.
CRP Management & Support Cost	1,341,809	0	0	1,341,809	Includes PMU Management cost and Overhead & Research Support cost.
Strategic Competitive Research Grant (Innovation Fund)	512,300	0	0	512,300	Innovation Fund (IF) will invest in untapped opportunities that can build a strong business case for sustainable and equitable benefits for smallholder producers of GLDC crops. IF will be planned at 100%.
New cross-cutting activity on Markets and Partnerships in Agri-Business (MPAB)	250,000	0	0	250,000	Includes salary and operational cost.
Total Budget	8,200,000	51,334,255	0	59,534,255	

List of participating Centers and other key partners

Tier I

ICRISAT: Sorghum, pearl millet, finger millet, chickpea, pigeonpea and groundnut

IITA: Cowpea and soybean

ICARDA: Lentil and chickpea

ICRAF: Agroforestry and Natural Resource Management

Tier 2

ILRI: Crop-livestock integration

IWMI: Water management

Bioversity International: Promote biodiversity on farms

CRP partners

WLE: Interface farms and landscapes, increase water-use efficiency

CCAFS: Climate-risk management tools and information

PIM: Foresight modelling tools to assess impacts

A4NH: Biofortification and food safety

LIVESTOCK: Dual-purpose varieties and hybrids

RICE, WHEAT, MAIZE, ROOTS, TUBERS AND BANANAS: Intercropping with dominant crops of the CRPs

Partners

Apex and SROs

Sub-Saharan Africa

FARA

CORAF/WECARD

CCARDESA

ASARECA

RUFORUM

WACCI

AWARD

South Asia

SAARC Agriculture Centre

APAARI

ICAR, India

Private Sector companies & consortia

Corteva Agriscience™

Advanta Seeds

Syngenta Foundation

Seed Co, Zimbabwe

Mars Chocolate

Microsoft

MANOBI-AFRICA, Senegal

Hybrid Parents Research Consortium, ICRISAT

African Seed Trade Association

India Pulses & Grains Association

Farmer Producer Organizations in India

NGO & Large Programs

Alliance for a Green Revolution in Africa

Catholic Relief Services (CRS)

CARE

Global Alliance for Improved Nutrition

Farm Africa

African Agricultural Technology Foundation

Self Employed Women's Association, India

Young Professionals for Agricultural (YPARD)

N2Africa

HarvestPlus

USAID Feed the Future Innovation Labs

Sorghum and Millet

Peanut & Mycotoxin

Legume

Climate-Resilient Sorghum

Climate Resilient Chickpea

Climate-Resilient Cowpea

ARIs

CSIRO, Australia

CIRAD, France

IRD, France

FAO Research and Extension

World Vegetable Center

SLU, Sweden

UWA, Australia



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