CGIAR Contribution To KULIMA Promoting Farming in Malawi: Improving the Access To and Use of Agriculture Research Innovations by Malawian Farmers

Quarter 2 Progress Report

1 August–31 October 2018

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Project Name: CGIAR Contribution to KULIMA Promoting Farming in Malawi: Improving the Access to and Use of Agriculture Research Innovations by Malawian Farmers.

Implemented by: International Potato Center (CIP), International Center for Tropical Agriculture (CIAT), International Maize and Wheat Improvement Center (CIMMYT), World Agroforestry Center (ICRAF), International Crop Research Institute for the Semi-Arid Tropics (ICRISAT), International Institute for Tropical Agriculture (IITA), World Fish Center (WFC).

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ACRONYMS

ADD	Agricultural Development Division
CA	Conservation agriculture
CBF	Community-based facilitator
CGIAR	Global Agricultural Research Partnership (formerly Consultative Group for International Agricultural Research)
CIAT	International Center for Tropical Agriculture
CIMMYT	International Maize and Wheat Improvement Center
CIP	International Potato Center
DAES	Department of Agricultural Extension Services
DARS	Department of Agricultural Research Services
DTM	Drought-tolerant maize
EU	European Union
FAW	Fall armyworm
FAO	Food and Agriculture Organization of the United Nations
FFS	Farmer field school
FMNR	Farmer-managed natural regeneration
GAPS	Good agronomic practices
GIZ	Gesellschaft für Internationale Zusammenarbeit GmbH
GoM	Government of Malawi
IAA	Integrated Agriculture Aquaculture
ICRAF	International Centre for Research in Agroforestry (World Agroforestry Center)
ICRISAT	International Crop Research Institute for the Semi-Arid Tropics
IITA	International Institute for Tropical Agriculture
IPM	Integrated pest management
ISFM	Integrated soil fertility management
KULIMA	Kutukula Ulimi m'Malawi (promoting farming in Malawi)
LRC	Land Resources Centre
M&E	Monitoring and evaluation
MoA	Ministry of Agriculture

MT	Master trainer
NGO	Nongovernmental organization
RTC	Residential training center
SHA	Self Help Africa
SO	Strategic objective
SSU	Seed Services Unit
STAM	Seed Trade Association of Malawi
WFC	World Fish Center

PROJECT OVERVIEW

This report summarizes the progress of implementing the Kutukula Ulimi m'Malawi (KULIMA) project, from 1 August to 31 October 2018 (Q2). This 15-month project (15 May 2018–31 August 2019) is funded by the European Union through the Gesellschaft für Internationale Zusammenarbeit GmbH (GIZ). It is part of a larger, 6-year KULIMA Action implemented by GIZ, the Food and Agriculture Organization of the United Nations (FAO), Self Help Africa (SHA), and the government of Malawi (GoM).

Under this first 15-month phase, funded at €1,998,076.54, the International Potato Center (CIP) is coordinating the contribution of six other CGIAR centers:

- International Center for Tropical Agriculture (CIAT)
- International Maize and Wheat Improvement Center (CIMMYT)
- International Centre for Research in Agroforestry (ICRAF/World Agroforestry Center)
- International Crop Research Institute for the Semi-Arid Tropics (ICRISAT)
- International Institute for Tropical Agriculture (IITA)
- World Fish Center (WFC)

KULIMA Action Objectives

The overall objective of the 6-year KULIMA Action program is to promote sustainable agricultural growth to increase incomes, employment, and food security in Malawi in the context of a changing climate. The program has three specific objectives (SOs) with different result areas:

SO1: *Agricultural productivity increased and production diversified in a participatory, sustainable, and climate-change resilient manner*

Result 1.1: Improved organization and delivery of national research and extension services

Result 1.2: Supply system of appropriate inputs and related technologies set up and meeting the needs to ensure increased, diversified, and sustainable production

Result 1.3: Farmers mobilized and supported to boost their agricultural production

Result 1.4: Government efficiently supported to increase investment for irrigation development

SO2: *Agricultural value chains developed or established and related income and employment opportunities created*

Result 2.1: Affordable loans made available to private sector-managed, demand-driven agricultural investments and used by value chain actors for expanding operations, including smallholders' operations.

Result 2.2: Value chain development plans for selected crops and other commodities developed and implemented, leading to increased, sustainable, and environmentally friendly growth in primary production, value adding, and viable enterprises in the value chain.

SO3: *Agriculture sector governance is strengthened.*

Result 3.1: The wider public is better informed and consulted on key issues in agriculture

Result 3.2: Strengthened accountability role of the Malawian Parliament on agriculture and agriculture-related issues

The CGIAR centers are expected to contribute to the achievement of Results 1.1 and 1.2 under SO1 of the greater KULIMA Action. In SO2, the CGIAR will also develop training packages and support input suppliers for selected GIZ value chains and facilitate best practices around restoration of soil fertility and land resources (i.e., natural resources management/climate change adaptation practices).

KEY CGIAR CONTRIBUTIONS TO KULIMA

The CGIAR centers are focusing on strengthening the organization and delivery mechanism of national agricultural research and extension services, in addition to improving the supply systems of appropriate information, knowledge, technologies, and inputs. The project is coordinated by GIZ working closely with relevant ministries and relevant departments of the GoM and FAO–Malawi. CIP is coordinating the activities of six other CGIAR centers located in Malawi to provide a wide range of science-based agricultural production technologies, training, and access to inputs and technical advice. The project is being implemented in 10 districts: Chitipa, Karonga, Nkhata Bay, Mzimba, Kasungu, Nkhotakota, Salima, Chiradzulu, Thyolo, and Mulanje. CGIAR's key responsibilities include:

- Develop and print technical content for farmer field school modules
- Train master trainers (MTs) at three residential training centers (RTCs)
- Procure inputs and establish study plots at RTCs and 15 outreach locations
- Conduct follow-up coaching for master trainers (on demand)
- Assess farmers' perceptions on technology and resulting adaptation needs
- Conduct further research on the selected technologies, innovations, and practices
- Develop and share communications/project briefs
- Provide advisory services on technologies, innovations, and practices to selected producers/ enterprises
- Support concrete partnerships for sustainable planting material supply system
- Train and support multipliers/suppliers of seeds/planting material/inputs in KULIMA districts
- Contribute to implementation and evaluation of integrated technology packages
- Facilitate Department of Agricultural Research Services staff participation in the activities
- Provide starter kits for trainings of community-based facilitators by MTs (coordinated by CIP)

1. OVERALL SECOND QUARTER PROJECT PROGRESS

This report summarizes the progress in the second quarter (Q2) of implementing the Kutukula Ulimi m'Malawi (KULIMA) project, from 1 August to 31 October 2018. This 15-month project (15 May 2018–31 August 2019) is funded by the European Union through the Gesellschaft für Internationale Zusammenarbeit GmbH (GIZ). The agreement between the International Potato Center (CIP)and GIZ was signed on 10 August and progress was made on sub-granting the other six CGIAR (CG) centers:

- International Center for Tropical Agriculture (CIAT)
- International Maize and Wheat Improvement Center (CIMMYT)
- International Centre for Research in Agroforestry (ICRAF/World Agroforestry Center)
- International Crop Research Institute for the Semi-Arid Tropics (ICRISAT)
- International Institute for Tropical Agriculture (IITA)
- World Fish Center (WFC)

This section of the report provides a technical update of progress under the main result areas.

1.1 RESULT 1: IMPROVED ORGANIZATION AND DELIVERY OF NATIONAL RESEARCH AND EXTENSION SERVICES

Main Activity 1.1: Identify innovations/technologies available and adapted for each agro-ecological zone of Malawi

Under this activity the project was expected to map existing innovations and technologies for each agro-ecological zone of Malawi, develop integrated technology packages to be used for training/ capacity building, and develop a joint "strategic plan" for rolling out the innovations and technologies to the three residential training centers (RTCs) and 15 outreach locations.

For this purpose, CIP organized a project start-up planning meeting in Lilongwe at Wamkulu Palace on 5–6 September 2018. The meeting attracted participants from all the six other CG centers (ICRISAT, IITA, ICRAF, CIAT, CIMMYT, and WFC) as well as Department of Agricultural Research Services (DARS), the Food and Agriculture Organization of the United Nations (FAO), Self Help Africa (SHA), GIZ, and the European Union (EU). The workshop aimed to review and agree the technologies/innovations proposed by each CGIAR center to determine those that were most suitable for each agro-ecological zone that formed the impact districts. The meeting provided opportunities to refine and prioritize technology packages to be included in the farmer field school (FFS) curriculum, discuss the project's work plan activities, exchange ideas, and define procedures for integration. Six centers are each leading an integrated technology package: Integrated Pest and Disease Management (ICRISAT); Aflatoxin control (IITA); Tree/Agroforestry-based Farming Systems (ICRAF); Integrated Soil Fertility Management and On-farm Water Management (CIAT); Conservation Agriculture (CA) (CIMMYT); and Integrated Agriculture Aquaculture (IAA) (World Fish Center) (Fig. 1).

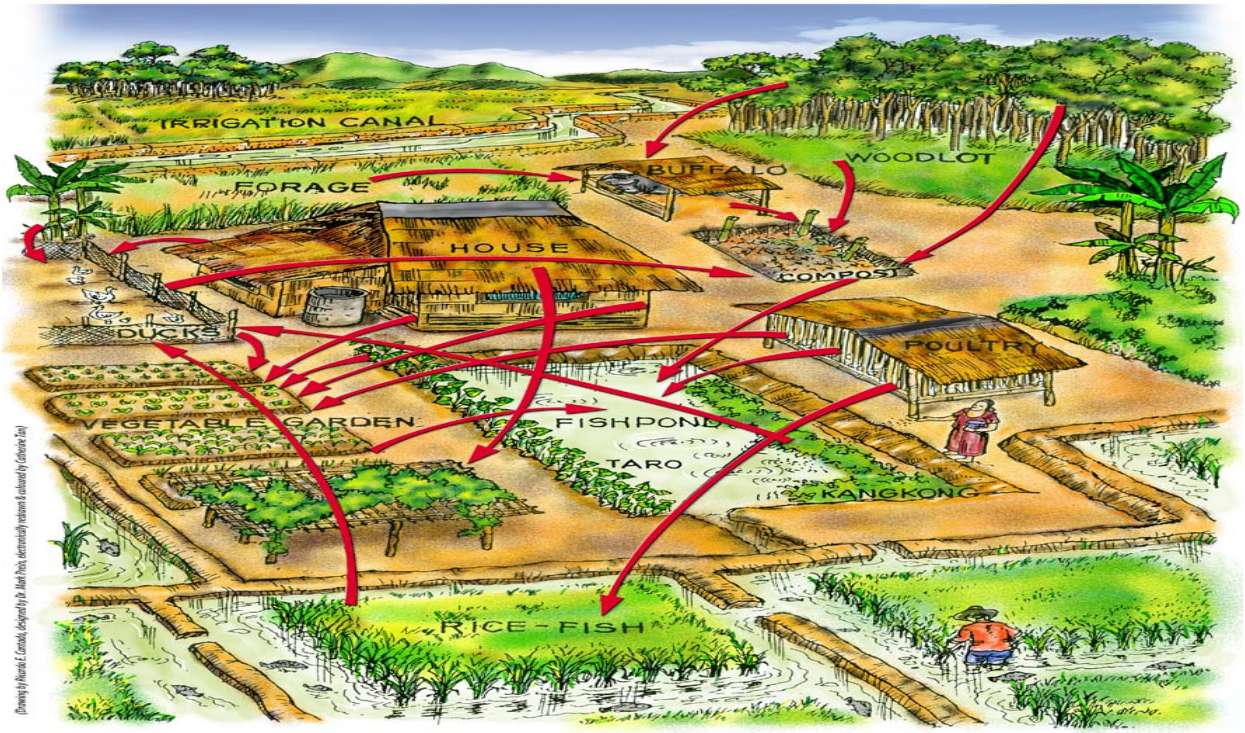

Figure 1. An example of technology integration presented by WFC: IAA.

These packages were developed with the understanding that the CG centers should not focus on their own standalone technologies, but would develop integrated packages that could address multiple production constraints faced by smallholder farmers. Through interactive group work around each technology package, the workshop served to iron out these packages in more detail and reach a joint understanding by each lead center on how to collaborate with other centers in the upcoming cohort of master trainers (MTs) (Fig. 2). **Annexes 1 and 2** summarize the information presented by each center. A consolidated presentation was developed, describing the centers' contribution to be presented in the government Agricultural Development Division (ADD) planning meetings. Going forward, participants agreed to continue working on this strategic plan for rolling out the technology packages.

Figure 2. Work planning session on integrated technologies at Wamkulu Palace.

Highlights for each center are:

- CIAT will be responsible for soil testing at the three RTCs and recommending and implementing soil amendment interventions for the study fields. The integrated soil fertility management (ISFM), soil and water conservation interventions will not be restricted to beans, but applied to other study plots where relevant or desirable.
- CIMMYT identified varieties of drought-tolerant maize (DTM) and nutritious maize and conservation agriculture (CA) as major technologies. The focus is on sustainable intensification practices to enhance the understanding of CA-based intensification options for maize–legume production system. CA is an integrated technology package consisting of intercropping maize with legumes like pigeon pea (with ICRISAT), crop rotation, soil residue cover, and minimal soil disturbance.
- CIP is not leading a specific package; however, it will integrate potato and sweetpotato technologies with ISFM practices led by CIAT, integrated pest management (IPM) led by ICRISAT, and integration with aquaculture led by WFC.
- ICRAF has developed agroforestry technology packages covering agroforestry fertilizer trees-intercrops to include (1) Tephrosia-maize (with CIMMYT); (2) Gliricidia-maize (with CIMMYT); (3) Sesbania-maize (with CIMMYT); (4) Gliricidia-maize-pigeon pea (with CIMMYT and ICRISAT); and (5) Faidherbia-maize/sorghum (with CIMMYT and ICRISAT). ICRAF will also focus on smallholder dairy protein fodder banks, fruit mother blocks and orchards, and other multipurpose tree species, such as farmer-managed natural regeneration (FMNR) intercrops.
- ICRISAT will take the lead in developing an integrated technology package to control fall armyworm (FAW) infestation in maize. This will require close collaboration with CIMMYT and ICRAF. Use of biopesticides and intercropping are likely contributions from ICRAF as strategies to be included in the package, as there has been increasing use of biopesticides (Neem and Tephrosia extracts) in the control of some devastating pests such as FAW and grain storage pests.
- IITA is leading on Aflatoxin control. An integrated package was developed in which CIMMYT is expected to establish study plots with their maize varieties alongside CA. IITA will apply Aflasafe to the maize plots. IITA also developed an integrated program with ICRISAT on aflatoxin management in groundnut in which ICRISAT will promote different varieties, tied ridges, mulching, and double row; IITA will apply Aflasafe to the plots. IITA intends to also support intensification of maize-based cropping systems through maize-soybean/cowpea rotation, to improve soil fertility (CIMMYT); IPM packages, using cassava, soybean, and cowpea and groundnut/pigeon pea as major components (ICRISAT); and nitrogen-fixing bean and soybean-cowpea intercrops (CIAT). IITA will work with WFC in testing the quality of fish feed for mycotoxin contamination as the growth and development of fish depend on the quality of feed fed during rearing. IITA will also support ICRISAT on IPM and integrated disease management to raise awareness on the temporal solution to the emerging diseases; the importance of quality planting materials; and basic agronomic practices that reduce the buildup of disease inoculum, identification, and management.
- WFC conducted a mapping exercise that complemented the baseline survey conducted by FAO. In general, the potential for fish farming in the 10 districts is large but production from the existing farms was very low because of use of poor quality seed as well as lack of knowledge on general principles of fish farming and feeding. WFC intends to address these knowledge gaps and develop agro-ecological-specific IAA systems that would increase fish production and allow farm

households to extend production period during the dry season and diversify into other food production techniques using the water from fish ponds. Legumes, banana, vegetable, maize, fruits, potato, and sweetpotato can be integrated with fish, depending on farmer preferences and production constraints in the outreach locations.

Although the workshop outcomes described above formed a first basis of a "strategic plan," the plans will be fine-tuned and amended as the project moves toward implementation (elaborated further in the next section). The final number of technologies to be introduced will depend on the available time slots in the MT course curriculum and the contributions by FAO and the ADDs to the MT courses that were not yet clearly understood during the planning workshop. As explained in the Section 2, several coordination meetings took place with all partners to fully grasp their roles and responsibilities. It is within this context that we see the strategic plan as a living document as it needs to be aligned to the joint vision for the MT course, with buy-in from of all KULIMA partners (GIZ, FAO, SHA, GoM/ADDs).

Main Activity 1.2: Train extension workers and lead farmers with the FFS approach to improve quality and accessibility of the national extension system

1.2.1 Develop technical content to be included in the FFS modules (innovation and technologies and natural resource management/climate change adaptation practices)

After the planning workshop in which the technology packages were further developed, these ideas needed to be turned into a proposed curriculum. During a 1-day meeting at Crossroads Hotel in Lilongwe on 24 October, all CG centers with their government counterparts (e.g., DARS, the National Aquaculture Center) developed and presented their proposed curriculum topics in a template provided by CIP. The team deliberated and agreed the size of the study plots, treatment combinations, and time required for the theoretical and practical sessions with the MTs. The group provided feedback to each center on issues such as duration of theory and practicals, possible overlaps between centers, and maximizing integration. The total combined duration of all topics should not exceed the estimated availability of time of the MTs who will be trained. This posed some challenges as the potential of the CG's contributions appeared to be larger than the estimated availability of time in the MT course. Each group incorporated the feedback and returned a final version to CIP after the workshop. CIP compiled all contributions in an overview of proposed training content (**Annex 3**). This overview was shared with FAO in order to incorporate the proposed topics into the curriculum for the next cohort of MTs. Before closing the meeting, it was agreed that all centers could start to develop some training materials on these topics. We agreed that CIP would prepare a CG-folder for each MT, and that centers would not facilitate training sessions without bringing handouts of training material. Some centers have readily available training material to use, whereas others started to develop material specifically for the course during this reporting period. Special emphasis in the initial stages should be on the protocols for study plots at the RTCs.

1.2.2 Train MTs on innovation and technologies (seed/input production and management) and natural resource management/climate change adaptation practices

The second cohort of MTs had not yet started in the reporting period, and the first cohort had graduated some months before the agreement with GIZ was signed. However, ICRAF still managed to conduct some activities. They visited all the three RTCs and 15 targeted outreach sites to assess the agroforestry practices and technologies being promoted and existing gaps. It was observed that in all the outreach sites, FFS have not piloted fertilizer tree technologies in their fields but expressed willingness to do so during the 2018–2019 growing season. FFS are operating on rented plots, which may affect promotion of long-term farming practices such as agroforestry, which require use of the

same plot in subsequent years. After sensitizing participants about this requirement (Fig. 3, left), ICRAF and community-based facilitators (CBFs) identified 10 individual farmers per outreach site who will plant short- to medium-duration fertilizer trees (sesbania, tephrosia, pigeon pea, gliricidia) and fruit trees in their fields and homesteads. Meanwhile, at the unsecure (in terms of tenure) outreach center (i.e., the FFS study center), ICRAF will promote a tree-based (sesbania, tephrosia, pigeon pea, gliricidia) soil fertility-enhancing technology intercropped with maize.

Green manure incorporation was done by ICRAF at Lisasadzi and Mzuzu RTCs toward the end of October (Fig. 3, right). Unfortunately, since the exercise did not coincide with MTs training, there was a missed opportunity for them to learn how to assess the quantity of green manure and its incorporation. ICRAF is developing a calendar for each tree-based technology to share with FAO to ensure that MTs do not miss key points of training.

Figure 3. ICRAF facilitator briefing farmers at Chilongolera FFS (left) and incorporation of tephrosia green manure during land preparation at Mzuzu RTC (right).

1.2.3 Acquire and provide the required quality inputs to be used for the practical training with establishment of trials in study plots (at RTCs, 15 outreach locations, and up to 80 training sites per season where MTs will be training CBFs)

All CG centers have assessed the types of inputs required for the study plots to be established at the RTCs and outreach locations. Inputs will be procured and distributed in the next quarter. During October 2018, CIAT sampled the soil at all three RTCs in Lisasadzi, Mzuzu, and Thuchira (see image on the report's cover). The aim of the exercise was to identify the status of the physical and chemical properties of the soils to determine the most appropriate and practical soil amelioration practices for higher productivity. Soil was sampled with hand-held manual augers at two depths: 0–20 cm for top soil and 21–40 cm for subsoil. Stratified random sampling was carried out, guided by the "adequately uniform" existing field blocks at each RTC. Lisasadzi and Mzuzu RTCs had two blocks each; Thuchira had one. The soil samples will be submitted to the Agricultural Research and Extension Trust Chemistry Laboratory for analysis, Results and recommendations will be reported in Q3.

1.2 Result 2: Supply System of Appropriate Inputs and Related Technologies Set Up and Meeting the Needs to Ensure Increased, Diversified, and Sustainable Production

Main Activity 2.1: Develop a sustainable system for production and distribution of quality planting material to producers in KULIMA

2.1.1 Develop an integrated concept on a sustainable system for production and distribution of quality seed and planting material to producers within KULIMA (including the value chains addressed within SO2)

Through the FFS school approach, the demand for seed of improved varieties and quality planting materials and other inputs is expected to increase over time. The project was thus tasked to develop a concept on a sustainable supply system for production and distribution of quality seed and planting materials for producers and other inputs within KULIMA. A 2-day workshop was organized by CIP at Crossroads Hotel on 22–23 October to:

- Develop approaches to make seed/planting material and other inputs available
- Develop action plans for implementing the sustainable seed supply systems
- Agree on partnership/communication modalities between CGIAR/DARS team and a consortium of various nongovernmental organizations (NGOs)

The workshop (Fig. 4) was attended by representatives from all the seven CG centers, GIZ, SHA, DARS, the National Aquaculture Center, and the Seed Trade Association of Malawi (STAM). After each center presented its proposed approaches, working groups were formed focusing on legumes, cereals, root and tuber crops, agroforestry and trees, and fish. The grouping was based on the botanical similarities among the crops vis-à-vis the uniqueness of their seed production methods. After the group work, a common seed production and delivery approach with an associated work plan was presented for each of the groups. Each group received feedback and comments from the team.

Figure 4. Work planning session at Crossroads Hotel on sustainable seed supply systems.

After the meeting the proposed approach was updated and sent by each group to CIP for consolidation into a joint concept. This concept will be made available in the next reporting period. Some highlights for each group are:

- **Legumes.** The target legumes include soybean, cowpea, beans, pigeon pea, and groundnuts. The legume seed supply system will be led by ICRISAT, CIAT, IITA, and DARS. Activities include production of early generation seed, identification and training of seed multipliers, distribution of planting materials, conducting seed fairs, production of pre-basic and basic seed, field inspections, training of agro-dealers, and linking farmers to agro-dealers.

- **Cereals.** Focus crops in the cereals seed supply systems includes maize, sorghum, and millet and will be led by CIMMYT, ICRISAT, and DARS in close collaboration with STAM and the Seed Services Unit. Activities include identification of agro-dealers; seed requirement assessments by crop by variety; a workshop for agro-dealers on seed quality (storage, handling, transport); training of agro-dealers on variety traits and attributes; a workshop on business management (linkages to seed companies and banks, marketing, loan default prevention); seed distribution and quality monitoring; and training for seed multipliers.

- **Agroforestry trees**. The agroforestry tree seed systems activities led by ICRAF are broadly categorized into tree crops for soil fertility improvement (i.e., tephrosia, pigeon pea, sesbania, gliricidia, faidherbia), fruits (i.e., mango, guava, oranges, avocado, pears), and fodder (calliandria, sesbania, leucaena, angustissima). For fruit trees, improved germplasm (scions and buds) will be sourced from ICRAF and DARS "Mother" blocks to establish village Mother blocks, and farmers will be trained on nursery practices, including grafting and budding. Sales to NGOs and other organizations will be promoted through linkages with community agroforestry tree seed banks, though much emphasis will be on self-sustaining production. The agroforestry seed supply system for pigeon pea will be developed in partnerships with ICRISAT. Land Resource Centre (LRC) will be partnered to ensure market supply of orthodox tree seeds. There will be joint trainings on the agroforestry tree seed management.

- **Roots and tubers.** This seed supply system includes potato and sweet potato to be led by CIP and DARS and cassava to be led by IITA and DARS. Since these are all vegetative propagated crops, the trainings and roll-out of the seed supply system will be integrated as much as possible and will respond to the demand estimates provided by the NGO consortium. Activities include identification of seed multipliers, early generation seed scouting and quality verification, basic seed purchase and distribution, establishment of seed multiplication centers, training seed multipliers, registering and inspection of seed multipliers, and linking multipliers to potential buyers.

- **Fish.** Species to be included in the supply system are Tilapia rendalli (chilunguni), Oreochomis shiranus (makuamba), Oreochromis karongae (chambo), and Clarias gariepinus (mlamba). The approach includes management of the genebank (parent stock) by public research institutions such as WFC and universities, distribution of primary brood stock to commercial or semi-commercial farms, and mass production of fry and/or fingerlings by hatchery operators. Specific activities include a project kick-off meeting with DARS and Department of Fisheries, preparation of training materials, identification of hatchery and nursery operators, setting up parent management centers at Domasi and Mzuzu, pond rehabilitation, recruitment of brood stock, fry and fingerling production, training of hatchery and nursery operators, distribution of brooders to hatchery operators and fingerling production, seed inspection and certification, monitoring, and technical backstopping.

During the reporting period, ICRAF began to procure planting materials for establishing sustainable seed supply system for fruits and other trees. They procured 1,500 assorted fruit tree seedlings for establishing 75 fruit Mother blocks (75 farmers), 150 kg of Tephrosia tree seed for 90 seed orchards (90 farmers), and 120,000 Gliricidia seedlings for 60 orchards (2,000 seedlings per farmer). ICRAF will finalize the distribution of these planting materials in Q3.

2. MANAGEMENT ISSUES

The GIZ-managed CGIAR project component consists of seven CGIAR centers embedded in a wider program of complex and interdependent partnerships with FAO, a consortium of NGOs, and different GoM departments. Naturally, starting up of such an initiative will require intensive management, partnership development, communication, and coordination beyond simply implementing work plan activities. This section highlights some of the management aspects that emerged during Q2.

2.1 COORDINATION ACTIVITIES WITH KULIMA IMPLEMENTING PARTNERS

Below we report the following highlights:

- CIP participated in a KULIMA joint work plan presentation to all program managers from the ADDs on 27 July at the Ministry of Agriculture (MoA) office, to clarify the CG's role to the program managers.
- CIP contributed to the planning for the district-level sensitization meetings. This included planning meetings at the MoA and contributing to the presentations to be given to the District Executive Committee and District Agriculture Extension Coordination Committee in each of the 10 project districts. There were three government-led teams: the MoA; Irrigation and Water Development—that is, the Department of Agricultural Extension Services (DAES), LRC, DARS, Department of Crop Development, Department of Agricultural Planning Services; and FAO, GIZ/CGIAR, and SHA. The teams traveled on 12–18 August for the sensitization meetings. Kennedy Siyabu (GIZ) joined the team in the northern region, Langson Samala (CIP) in the central region, and Dr. Joseph Nagoli (WFC) in the southern region districts.
- Dr. Paul Demo (CIP's regional director) and Daniel van Vugt (KULIMA project manager) visited the DARS director, Dr. Wilkson Makumba, to discuss the collaboration between DARS and the CGIAR on the KULIMA project. It was explained that each center intends to collaborate with DARS and that some of the budget is reserved for DARS' staff to participate in the activities. This initiative was well received by Dr. Makumba.
- CIP's project manager and technician visited Thutchila RTC and two outreach groups on Monday, 8 October. Interactions with the ADD–KULIMA desk officer, RTC principal, FAO staff, and farmers in the outreach groups resulted in better joint understanding of expected CGIAR activities and technologies to be introduced in the southern region.
- On Tuesday, 9 October, CIP's project manager gave a presentation on KULIMA at the DARS Annual Review and Planning Meeting at Bvumbwe Research Station in Thyolo. It was observed that DARS was not yet very familiar with the details of KULIMA, and the presentation was an eye-opener for most staff attending the meeting.
- CIP's project manager participated in two coordination meetings with KULIMA partners GIZ, FAO, SHA, EU, and GoM. These took place on 30 August and 12 October and helped all partners to better understand their roles and responsibilities in the preparation for the next cohort of MTs.

- CIP participated in a meeting with FAO on 20 August to discuss roles and responsibilities of FAO and GIZ/CGIAR in relation to other partners such as the subject matter specialists from the ADDs. In this meeting it was agreed that the CG's component should participate in upcoming ADD planning meetings to present the GIZ/CGIAR contributions to the MT course.
- These ADD planning meetings (i.e., to prepare for the next cohort of MTs) were attended by CIP (Daniel van Vugt) and GIZ (Zewdy) in Kasungu on 18 October and by GIZ (Kennedy Siyabu) in Thutchila on 19 October and on 26 October in Mzuzu. Presentations were given on the GIZ/CGIAR technologies and innovations.
- On 19 October a meeting took place at CIP between Dr. Chisomo Kumbuyo, Imprest administrator of the Project Coordination Unit in the government component of KULIMA, GIZ, and CIP. Discussed was the possible overlap between DARS and CG activities in the KULIMA work plan. It was also resolved that another meeting with FAO would be needed, which Dr. Kumbuyo called for.
- The meeting at FAO took place on 30 October; representative from GIZ, CIP, NGOs, and the Imprest administrator attended. The meeting clarified that involvement of the ADD staff in the MT courses is covered under the FAO–ADD letters of agreement for each of the three ADDs. It was agreed that GIZ will cover casual labor costs for the study plots established by the CGIAR.
- CIP (Daniel van Vugt and Kareem Longwe) also attended a monitoring and evaluation (M&E) workshop at Ufulu Gardens in Lilongwe, facilitated by Henk Remme on Thursday, 25 October. Mr. Remme is a consultant engaged by the EU to develop an overall M&E framework/plan for KULIMA. In the workshop all partners gave a presentation and jointly reviewed the existing KULIMA M&E framework.

2.2 VISIBILITY ACTIVITIES

The CGIAR participated in some events to enhance visibility:

- CIP's project manager participated in two planning meetings at the EU delegation to prepare for the National Agricultural Fair (Fig. 5). The 2018 fair, held on 12–15 September 2018 in Blantyre, was officially opened by the state president of the Republic of Malawi, His Excellence Professor Arthur Peter Muthalika. All CG centers participated in preparation for the displays at the trade fair grounds.
- An EU-funded debate around the World Food Day celebrations took place on Friday, 26 October at the Natural Resources College Campus of Lilongwe University of Agriculture and Natural Resources. The EU ambassador was part of the event. CIP coordinated a display by linking up with the centers on the technologies to display. Kareem Longwe and David Mthobwa of CIP attended.

Figure 5. KULIMA GIZ/CGIAR displays at the National Agricultural Fair.

2.3 CIP Coordination of CGIAR contribution

- The agreement between CIP and GIZ was signed on 10 August, and much effort was placed on preparing the subgrant agreements for the six other centers. As a result, agreements were signed by IITA, CIMMYT, ICRAF, and WFC; those with ICRISAT and CIAT are expected to be signed early in Q3.
- To coordinate the technical aspects, CIP organized a 2-day planning workshop (see details under activities) on selection of integrated technology packages, a 2-day workshop to develop an integrated seed system concept, and a 1-day program on curriculum development for the MT course.

2.4 Recruitment

- CIP supported GIZ with development of terms of reference for seed system specialists for consultants to work on value chains that are not directly supported by CGIAR (e.g., rice, macadamia, chilies, peppers). The other centers contributed by suggesting recommended experts.
- GIZ planned on behalf of CIP to recruit an international potato and sweetpotato consultant to train a CIP research associate on potato and sweetpotato and to contribute to development of training material. Delays in the recruitment process prevented this from materializing as the selected consultant had taken on another assignment.
- CIP's research associate agronomist, Kareem Longwe, started work in mid-August, and the technician (David Mthobwa) began in early September.
- CIP identified an M&E specialist for the Project Management Unit. Unfortunately, after he signed the contract, the specialist did not report for duties. We anticipate that another candidate may be selected to start work in Q3.
- After seeking approval from GIZ, CIP re-engaged a cleaner/receptionist for the Lilongwe office from mid-August.

2.5 MANAGEMENT ISSUES AND CHALLENGES RAISED BY CGIAR PARTNERS

From the quarterly reports submitted by partners, this section presents a synthesis of management issues and challenges raised by partners. Starting with administrative and management related topics, the following issues were raised:

- The project started later than expected due to the time it took for CIP to sign a contract with GIZ and for the partners to sign a contract with CIP. This affected ,for example, CIMMYT's plans to roll out trainings of seed companies and agro-dealers, which has been shifted to June 2019. WFC plans for pond construction, which is ideal during dry season.
- On the one hand, it was mentioned that there were more meetings than implementation of the actual project activities. On the other hand, it is important that CIP take a leading role in providing guidance to all the CG centers for harmonized implementation of project activities so that centers do not work in isolation and better maximize integration. Generally, centers are looking forward to moving beyond meetings to implementation on the ground as soon as possible.
- In some cases there is a perceived mismatch between how centers are used to operating and the GIZ requirements. Concerns mentioned include (1) accommodation costs are sometimes above the allowable ceilings; (2) travel rates are different from institutional rates, which makes it difficult to prepare vouchers; and (3) the need to introduce timesheets for staff who are not fulltime on the projects that will need management approval.
- DARS is encouraged to participate in activities. But there have been inconsistencies in their attendance at different meetings, in some cases caused by last-minute changes in project activities.
- The CIMMYT agronomist has changed, while the number of staff and time allocation of each staff has remained the same.

Regarding the technical aspects:

- WFC decided that because security and ownership and management of aquaculture affect production, all study sites will be established at outreach stations and not at the RTCs. Thuchila RTC and surrounding outreach are relatively dry, hence have minimal potential for aquaculture. Therefore, WFC will put a relay cropping at one outreach station. This will allow rain-fed fish production relayed by crop production during dry season.
- The assessment conducted by ICRAF revealed that many FFS are operating from rented plots, thereby posing a significant challenge for adoption and sustainability of agroforestry systems. As a remedy, ICRAF sensitized the FFS on the need to have study plots on secure fields for such interventions to be well implemented. Again, ICRAF, as a temporary measure, targeted individual farmers from FFS who will plant fruit and fodder trees in their fields so that some members can learn from them.
- There is evidence that trees established at the RTCs were not optimally cared for during the dry season. Watering of fruit trees was inadequate and resulted in poor growth. Another observation was that at Lisasadzi RTC, leaves of Tephrosia were inadvertently harvested and used as a biopesticide when the objective was purely for green manure. (There was very little leaf biomass left to apply as green manure.) Efforts will be made to establish separate plantings for biopesticide purposes to avoid conflict of objectives.

- Participation of MTs in agroforestry activities (management of trees, fire protection, green manure incorporation) during the dry season was not possible due to absence of any scheduled trainings. A general concern is that MTs may miss dry-season farming activities and only experience partial learning due to scheduling of the courses that are skewed toward the dryland farming calendar.

2.6 Monitoring and Evaluation

For this project, the M&E requirements are not yet fully clear. Since the EU has tasked a consultant to develop an overall framework, GIZ has not yet clearly defined the M&E requirements to the CGIAR consortium. A draft M&E table, mainly based on the output indicators in the proposal, has been shared with the participating centers. In Q3 we anticipate that the project will have an M&E specialist in place. Consequently, we expect to engage with partners and donors on a better understanding of the M&E data collection tools to be developed in response to the reporting requirements.

3. PLANNED ACTIVITIES FOR NEXT QUARTER

In Q3 (Nov. 2018–Jan. 2019) the project will mainly focus on the following key areas of work:

- Sign the sub-agreements with ICRISAT and CIAT.
- Recruit for an M&E specialist and driver for CIP.
- Organize an administrative and finance management workshop for CGIAR with GIZ.
- Complete the concept for sustainable seed supply system.
- Start implementation of seed system activities by all centers.
- Hold coordination meetings with other KULIMA partners (e.g., SHA, FAO, GoM).
- Hold planning meetings with ADDs and all CGIAR centers in each RTC to prepare for planting.
- Develop and print training materials for the upcoming cohort of MTs.
- Establish study plots at RTCs and outreach locations by all centers (fish ponds in selected outreach groups).
- Develop starter kits with seed and inputs from CG centers, and procure and distribute to the 84 CBF training sites across 10 districts.

ANNEX 1. SUMMARY OF THE PRESENTATIONS MADE BY CGIAR CENTERS AT WAMKULU PLANNING WORKSHOPS

CG Center/ Presenter	Key Technologies	Innovation/Technology Package	Needs Being Addressed	Partners
CIAT/ E. Kaima	✓ Bean varieties (based on market classes for dry bean: red, red-mottled, and the sugar type) ✓ High-iron bean varieties	✓ Integrated soil & waters conservation management	✓ Malnutrition ✓ Food security ✓ Low soil fertility ✓ Soil erosion ✓ Water scarcity	✓ DARS, DAES ✓ Department of Land Resources ✓ Seed suppliers (CBSP, STAM) ✓ Other CGIAR centers
CIMMYT/ W. Kalumula	✓ Improved-maize production system ✓ Climate-smart agriculture ✓ DTM varieties + CA ✓ FAW response ✓ Biofortification (orange maize and quality protein maize) for nutritional-sensitive agriculture	✓ Conservation agriculture	✓ Malnutrition ✓ Climate change (drought) ✓ Knowledge and skills for improved farming systems ✓ Dietary diversification	✓ DARS, DAES ✓ STAM ✓ Agro-dealers ✓ Grain processors ✓ TLC ✓ SHA, GIZ, FAO ✓ CG centers
CIP/ D. van Vugt	✓ High-yielding, vitamin A-rich orange-fleshed sweetpotato varieties ✓ Sweetpotato rapid vine multiplication ✓ Improved storage technologies ✓ High-yielding, disease-resistant, and consumer-preferred potato varieties		✓ Climate change adaptation ✓ Natural resources management ✓ Postharvest losses ✓ Food and nutrition security	✓ WFC ✓ DARS ✓ DAES ✓ FAO ✓ NGO Consortium
ICRAF/ J. Njoloma	✓ Fertilizer trees (short, medium, and long term) ✓ Fruit trees ✓ Fodder trees	✓ Agroforestry fertilizer trees-intercrops. ✓ FMNR	✓ Climate change, erratic rainfall, drought ✓ Declining soil nutrient capital ✓ High deforestation rates coupled with loss of biodiversity ✓ Land degradation ✓ Access to wood fuel ✓ Widespread poverty ✓ Food and nutrition insecurity ✓ High illiteracy rates ✓ Disease (HIV/AIDS), malaria ✓ Lack of markets for agricultural products	✓ CIMMYT ✓ ICRISAT ✓ DARS ✓ LRC department
ICRISAT/ A.Ngwira	✓ Nutrient-dense and resilient groundnuts genotypes ✓ Medium-maturing pigeon pea varieties with market- and farmer-preferred traits ✓ Twin row planting pattern in	✓ Integrated plant management and IPM	✓ Reduced vulnerability to multiple stresses ✓ Increased productivity and incomes of smallholder farmers ✓ Improved access to quality seed ✓ Enhanced knowledge on	✓ GIZ ✓ DARS ✓ CIMMYT ✓ ICRAF ✓ DAES ✓ NGOs consortium

CG Center/ Presenter	Key Technologies	Innovation/Technology Package	Needs Being Addressed	Partners
	groundnut production ✓ Legume–cereal and legume–legume intensification technologies		management of various commodities ✓ Expanded network of partners to support farmers in their production and marketing of commodities	✓ Farmer groups and farmers
IITA/ G. Akinwale	✓ High-yielding and client-preferred cassava varieties, resistant to cassava mosaic disease and cassava brown strike disease ✓ Improved soil and crop management practices for cassava production ✓ Rapid cassava multiplication techniques ✓ Intensifying maize-based cropping systems ✓ Rapid multiplication of clean planting materials of banana ✓ Postharvest handling technologies	✓ Aflasafe – Aflatoxin control ✓ Legume–cereals intercropping systems	✓ Postharvest losses ✓ Climate change ✓ Low soil fertility ✓ Land degradation ✓ Low productivity ✓ Unavailability of planting materials ✓ Aflatoxin	✓ IITA ✓ ICRISAT ✓ DARS ✓ DAES ✓ CIMMYT ✓ NGOs
WFC/ J. Nagoli	✓ Fish in agricultural systems	✓ Integrated aquaculture–agriculture ✓ Sustainable seed supply system	✓ Resilient small-scale farms ✓ Food and nutrition security ✓ Economic benefits	✓ Department of Fisheries (Research & Extension) ✓ DARS, DAES ✓ CIP, ICRISAT, CIAT ✓ CIMMYT

ANNEX 2. INTEGRATED TECHNOLOGY PACKAGES DEVELOPED DURING THE KULIMA PLANNING WORKSHOP AT WAMKULU PALACE

Integrated Technology Package	Approaches	Technologies	Suitable Agro-ecologies	Partners	Requirements
CIMMYT: Conservation Agriculture	Guiding principles for conservation agriculture: ✓ Minimum soil disturbance – tilling the plant station ✓ Ground cover/crop residue incorporation ✓ Crop rotation/crop association	**Crop associations** ✓ Cereal and legume combination **Ground cover materials** ✓ 2 –4 t/ha of maize stover or groundnut haulms ✓ DTM and nutrient-dense maize varieties	All the 3 RTCs and outreach centers	✓ DARS ✓ DAES ✓ SHA ✓ GIZ ✓ FAO ✓ CG centers	✓ Land availability ✓ Size of residue cover ✓ Pigeon peas V T. vogelli ✓ Livestock competition for crop residues
WFC: Integrated Agriculture Aquaculture	✓ Promote early-maturing crop varieties ✓ Seasonal relay cropping to be promoted in areas where water is a challenge ✓ Cassava and sweetpotato rapid multiplication ✓ Fruits to be integrated (mango, bananas, paw paws) ✓ Fodder banks (to also save as feed for livestock)	✓ Fish pond–sweetpotato integration ✓ Fish–bean integration (soya, beans) ✓ Fish–maize–bean integration ✓ Fish–vegetable integration ✓ Seasonal relay cropping	**Mzuzu RTC** ✓ Nkhatabay ✓ Mzimba North ✓ Karonga ✓ Chitipa **Lisasadzi RTC** ✓ Nkhotakota ✓ Salima ✓ Kasungu **Thuchila RTC** ✓ Thyolo ✓ Mulanje ✓ Chiladzulu	All CG for seed, variety choice, and farming guidelines ✓ CIMMYT: Maize ✓ ICRAF: Fruit trees ✓ CIP: Potato and sweetpotato, vine multiplication ✓ CIAT: Beans, soil, and water conservation ✓ ICRISAT: Pigeon peas ✓ IITA: Soya, cow peas, banana, and Aflatoxin control	✓ Water source, availability, and quality ✓ Soil suitability ✓ Proximity and accessibility ✓ Availability of quality seeds
ICRAF: Tree-based Farming Systems	✓ Production of quality planting materials ✓ Support establishment of study plots for the selected agroforestry-based innovations (site inspection, land prep, establishment) ✓ Provide assistance through MTs and community groups engaged in multiplication of planting materials (150 farmers from outreach groups)	✓ Agroforestry fertilizer trees-intercrops ✓ Smallholder dairy fodder banks ✓ Fruit orchards ✓ Multi-tree species (FMNR)-intercrops	In all the RTCs In all the 15 outreach locations	✓ CIMMYT ✓ ICRISAT ✓ DARS ✓ LRCD	✓ Enough land ✓ Fruit tree growing ✓ FMNR

IITA: Aflatoxin Control	✓ Produce and distribute Aflasafe ✓ Provide training in good agronomic practices (GAPs)during crop growth (pre- and postharvest) ✓ Integrate IITA-mandated crops into other centers' packages	✓ Aflasafe ✓ Soil fertility management: soybean, cowpea + maize will contribute to soil fertility (CIMMYT) ✓ IPM: cassava, soybean, cowpea (ICRISAT) ✓ Nitrogen fixing: beans and soybean cowpea intercrop (CIAT)	Aflasafe, cowpea, soybean and cassava can work in all agro-ecological zones	✓ CIMMYT and ICRISAT - establish the study plots for Aflasafe application ✓ IITA will set study plots and apply Aflasafe ✓ IITA will ensure the quality of fish feed as well as the processed fish	✓ Land area: TBD ✓ Irrigation (we depend on rain-fed agriculture) ✓ Inputs: TBD
ICRISAT: Integrated Pest Management and IPM	✓ Raise awareness on important pests and diseases for the various commodities ✓ Empower stakeholders in the identification of pests and diseases and their management ✓ Data collection during the entire cropping season to build evidence for advocacy	✓ Preservation and augmentation of natural enemies ✓ Specific application of the principles based on the needs of CG centers, FAO, and MTs ✓ Quality of planting material and health of the production environment	All RTCs and outreach sites	All stakeholders will develop priorities for each center in collaboration with FAO MTs	✓ Will depend on the established study plots by all other CGIAR centers
CIAT: ISFM & Water Conservation	✓ To start with soil samples collection and analyses to draw recommendation for improvement of soils at the three RTCs ✓ Selection of technologies to demonstrate at the RTCs will be based on priority crops selected	CIAT will demonstrate the ISFM technologies: ✓ Soil water harvesting and soil moisture conservation technologies ✓ Rotations between cereals and legumes	ISFM technologies are suitable for all agro-ecologies	✓ IITA & ICRISAT: Doubled up legume technologies ✓ ICRAF: Water conservation technologies ✓ DARS: Soil analysis, planting material ✓ DAES: Participatory technology evaluation/ identify farmer-preferred bean technologies ✓ Department of Land Resources: Testing integrated soil fertility and water management technologies	✓ Land area: implemented in study plots established by other centers ✓ Inputs: seed

ANNEX 3. TRAINING CONTENT DEFINED IN WORKSHOP AT CROSSROADS HOTEL ON 24 OCTOBER 2018

Outline of Training Contents for Crop Production and Integrated Technologies by CGIAR/DARS

1. ROOTS AND TUBER CROPS

1.1 Potato (CIP)

i. Introduction
ii. Understand protocols for study plots
iii. Characteristics for varieties
iv. GAPs
v. Postharvest handling and storage
vi. Seed handling and sprouting
vii. Positive and negative selection
viii. Pest and disease identification and control

Study plots/ practical: Potato varieties, diffuse light store, positive & negative selection

Time for theory (hours):6

Time for practical (hours): 9

Land area required (m^2): 141

1.2 Sweetpotato (CIP)

i. Introduction
ii. Understand protocols for study plots
iii. Characteristics of all available varieties (white, yellow, orange fleshed)
iv. GAPs
v. Postharvest handling and storage
vi. Pest disease and disease identification and control
vii. Processing and utilization

Study plots/ practical: Sweetpotato varieties, rapid vine multiplication

Time for theory (hours):6

Time for practical (hours): 12

Land area required (m^2): 240

1.3 Cassava (IITA)

i. Introduction
ii. Understand protocols for study plots
iii. Characteristics of all available varieties
iv. GAPs
v. Postharvest handling and storage
vi. Processing and utilization
vii. Pest and disease identification
viii. Processing and utilization

Study plots/ practical: Cassava varieties, rapid seed multiplication, pest & disease identification

Time for theory (hours):6

Time for practical (hours): 4

Land area required (m^2): 250

1.4 Seed standards for root and tuber crops (IITA/CIP/DARS/Seed Services Unit)

Seed production practices for sweetpotato, cassava, and Irish potato

Time for theory (hours): 4

2. LEGUMES

2.1 Common beans (CIAT)

i. Introduction
ii. Importance of beans and the diversity of bean types grown in Malawi
iii. Production constraints
iv. Released bean varieties in Malawi
v. Opportunities for increasing yield
vi. Study plot protocol briefing
vii. GAPs
viii. Control of common pests and diseases through IPM
ix. Harvesting and postharvest operations
    - Harvesting
    - Postharvest operations
    - Drying, winnowing and sorting, measuring moisture content, treatment, and storage

Study plots/practicals: High-iron, drought-tolerant, and market classes (sugar type, red mottled, red kidney and navy bean varieties

Time for theory (hours):7.5

Time for practical (hours): 5

Land area required (m^2): 360

2.2 Groundnuts and pigeon peas (ICRISAT)

i. Introduction
ii. Protocol procedure
iii. Variety description
iv. Disease and pest management
v. Postharvest handling
vi. Aflatoxin management in groundnuts

Study plots/practicals: Groundnut varieties, pigeon pea varieties

Time for theory (hours):6

Time for practical (hours): 8

Land area required (m^2): 600

2.3 Legume–legume and cereal–legumes intensification technologies (ICRISAT)

i. Introduction
ii. Protocol procedure
iii. Management practices
iv. Disease and pest management
v. Postharvest management

Study plots/practicals: Pigeon pea and groundnuts intercropping, maize and pigeon pea intercropping

Time for theory (hours):6

Time for practical (hours): 8

Land area required (m^2): 600

2.4 Soybean (IITA)

i. Understand protocol for study plot and data collection
ii. Released soybean varieties with their key attributes
iii. Soybean phenology description
iv. Soybean nutrient management
v. GAPs
vi. Pest and disease management
vii. Production of quality soybean seed and quality control

Study plot/practicals: Field layout for study plot, application of fertilizer and inoculant, variety identification and rogueing, and pest and disease identification

Time for theory (hours):8

Time for practical (hours): 4

Areas required (m^2): 400

2.5 Cowpea (IITA)

i. Understand protocol for study plot and data collection
ii. Released cowpea varieties with their key attributes
iii. Cowpea phenology description
iv. GAPs
v. Pest and diseases management
vi. Postharvest handling and storage
vii. Production of quality cowpea seed and seed internal quality control

Study plot/practicals: Field layout for study plot, application of fertilizer and inoculant, variety identification and rogueing, and pest and disease identification

Time for theory (hours):8

Time for practical (hours): 4

Areas required (m^2): 300

3. CEREALS

3.1 Maize, DTM, and biofortification (CIMMYT)

i. Protocols for study plot
ii. GAPs for maize production
    - Pest and diseases identification and management
    - DTM attributes
    - Fertilizer application rates, new fertilizer formulation
    - Data collection
iii. Intro to biofortification and variety development
iv. Grain storage
v. Postharvest handling
    - PICS bags
    - Moisture content for storage
vi. Commercialization

Study plots/practicals: Maize varieties under CA and conventional practice with and without Aflasafe application. Postharvest two treatments PICS bags and conventional bags for storage.

Time for theory (hours):9

Time for practical (hours): 12

Land area required (m^2): 900

4. FISH

4.1 Fish (WFC)

i. Understand protocol for study sites
ii. Importance of aquaculture and production systems
iii. Pond designs and construction
iv. Pond liming and fertilization
v. Pond stocking and restocking
vi. Fish feeds and feeding
vii. General pond management
viii. Fish markets and marketing
ix. Fish harvesting
x. Fish breeding
xi. Nursery management
xii. Handling and transporting fingerlings
xiii. Fish parasites and diseases

Study plots/practicals: Sexing

Time for theory (hours):17

Time for practical (hours): 40

Land area required (m^2): Outreach sites, 1,200 for each site

5. AGROFORESTRY

5.1 Agroforestry (ICRAF)

i. Concepts, principles, and practices of agroforestry (2 T; 2 P hours; T = theory, P = practical)
   - ✓ Agroforests for soil fertility improvement
   - ✓ Agroforests for high quality protein fodder production.
   - ✓ Agroforests for fruit production
   - ✓ Agroforests for tree cover, temperature control, windbreaks, shade, timber

ii. Fertilizer trees and soil fertility management (3 T, 6 P hours)
   - ✓ Species and seed source selection
     - Annual relay shrub species
     - Coppicing species and intercropping
     - High canopy tree species and intercropping
     - Superior seed sources
   - ✓ Seed requirements
   - ✓ Nursery establishment and direct sowing
   - ✓ Nursery management
   - ✓ Pre-sowing treatments, sowing depths, watering, hardening, shoot and root pruning
   - ✓ Tree and crop management
   - ✓ Spacing, pitting, out-planting
   - ✓ Leaf litter incorporation
   - ✓ Mineral fertilizer supplementation
   - ✓ Coppicing and coppice management
   - ✓ Resilience (to drought, dry spells, flooding) of the system

iii. Tree protein fodder banks in smallholder dairy system (2 T, 4 P hours)
   - ✓ Species and seed sources selection
   - ✓ Raising planting material (nursery, direct sown, cuttings)
   - ✓ Areas for possible tree establishment on farm
   - ✓ Leaf harvesting, processing, preservation, and storage
   - ✓ Feed formulation and utilization

iv. Fruit production (3 T, 6 P hours)
   - ✓ Concept and principles of grafting and budding
   - ✓ Cultivars selection for mangoes, oranges, avocadoes, and pawpaws
   - ✓ Raising rootstock
   - ✓ Selection and handling scions and buds
   - ✓ Grafting and budding techniques
   - ✓ Manuring and fertilization
   - ✓ Pests, diseases, and biopesticides
   - ✓ Harvesting and fruit-handling and group marketing

v. Famer-managed natural regeneration of trees (2 T, 4 P hours)
   - ✓ Concept and management of regenerants
   - ✓ Regenerating trees on crop fields
   - ✓ Regenerating trees on water catchments and deforested landscapes

vi. Pests and disease control in agroforests (1.5 T, 3 P hours)
   - ✓ Role of intercropping and role of trees
   - ✓ Biopesticides

vii. Land use planning for agroforestry systems (1 T, 2 P hours)
- ✓ Developing land use plans with agroforestry systems
- ✓ Role of community involvement and bylaws
- ✓ Tree leaf biomass assessment (estimating available green manure)

Study plots/ practical: agroforestry fertilizer trees–intercrops, multitree species (FMNR)-intercrops, fruit tree species,
Time for theory (hours):14.5 (approximately 2 days)
Time for practical (hours): 27 (approximately 3 days)
Land area required (m^2): 1,608

6. INTEGRATED TECHNOLOGIES PACKAGES

6.1 Integrated aquaculture agriculture–ecosystem restoration (WFC)

Study plots/practicals: Fish with vegetables, sweetpotatoes, bananas, legumes, cereals, poultry
Time for theory (hours):4
Time for practical (hours): 6
Land area required (m^2): In outreach locations only

6.2 ISFM and water conservation technologies (CIAT)

Integrated soil fertility management

i. Understanding crop nutrient requirements for high productivity
ii. Interpretation of soil analysis results and recommendations
iii. Inorganic fertilizer and farm yard manure use based on soil analysis results,
iv. Rotations between cereals and legumes
v. Double legume cropping, including with fertilizer trees
vi. Legume–cereal intercropping
vii. Liming acidic soils
viii. Reduced tillage (jointly with CIMMYT)

Water conservation technologies:

i. Principles of soil water management
ii. Use of box (tied) ridges and mulching (other techniques will be advanced in subsequent years)
iii. Use of crops with different rooting depth.
iv. Planting densities

Study plots/practicals: ISFWM in study plots: box ridges, integration of fertilizer trees
Time for theory (hours):3
Time for practical (hours): 2
Land area required (m^2): 360

6.3. Conservation agriculture (CIMMYT)

i. Principles of CA
ii. Management of CA plots
iii. Comparison of benefits and challenges from CA as compared to conventional practice

Study plots/practicals: To be integrated into study plots under maize

Time for theory (hours):3

Time for practical (hours): 2

Land area required (m^2): 360

6.4 Integrated pests and disease management (ICRISAT)

i. FAW control
ii. Preservation and augmentation of natural enemies—identification and matching of natural enemies and pests—reduce the use of insecticides
iii. Raise awareness on important pests and diseases for the various commodities
iv. Quality of planting material including assessment of the environment where it was produced
v. Health of the production environment including healthy soils

Study plots/practicals: To be integrated into study plots
Time for theory (hours):4
Time for practical (hours): 6

6.5 Aflatoxin management in maize and groundnut (IITA)

i. Agronomy of maize and groundnut production
ii. Knowledge on occurrence of aflatoxin and impact on health and trade
iii. Prevalence of aflatoxin in crops
iv. Pre- and postharvest management practices for aflatoxin reduction
v. Testing for aflatoxin to ensure quality compliance

Double row groundnut planting

i. Aflatoxin management
ii. Protocol understanding
iii. Postharvest management

Study plot/practicals: Single row, double row, tide ridges, Aflasafe, CA, plant spacing, plant population as a way of reducing aflatoxin and postharvest management

Time for theory (hours): 8

Time for practical (hours): 4

Areas required (m^2): 300

The International Potato Center (known by its Spanish acronym CIP) is a research-for-development organization with a focus on potato, sweetpotato, and Andean roots and tubers. CIP is dedicated to delivering sustainable science-based solutions to the pressing world issues of hunger, poverty, gender equity, climate change, and the preservation of our Earth's fragile biodiversity and natural resources.
www.cipotato.org

CIP is a member of CGIAR.

CGIAR is a global research partnership for a food-secure future. Its science is carried out by 15 research centers in close collaboration with hundreds of partners across the globe.

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