Catalogue of Innovations

Putting Research into Use for Nutrition, Sustainable Agriculture and Resilience programme (PRUNSAR)

IFAD
Investing in rural people

Originators:

International Fund for Agricultural Development
Agricultural Research for Development Unit (AR4D)

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Acronyms

ASAP	Adaptation for Smallholder Agriculture Programme
APVC	Agricultural production and value chain
AR4D	Agricultural research for development
CAAS	Centres for Agri-enterprises and Agro Services
CCAFS	CGIAR Research Program on Climate Change, Agriculture and Food Security
CFR	Community fish refuge
CIAT	International Centre for Tropical Agriculture
CIP	International Potato Centre
CIS	Climate information services
COP	Community of practice
CSA	Climate-smart agriculture
DST	Decision support tool
DTV	Drought-tolerant variety
ECO-PPR	Epidemiology and control of peste des petits ruminants
EU	European Union
FBL	Flood-based livelihoods
FBLS	Flood-based livelihood systems
FBS	Farmer business School
FFS	Farmer field school
GIFT	Genetic improvement of farmed tilapia
GIS	Geographic information system
HH	Household
ICRAF	World Agroforestry
ICT	Information and communications technology
IFAD	International Fund for Agricultural Development
ILRI	International Livestock Research Institute
INBAR	International Network for Bamboo and Rattan Research
IRRI	International Rice Research Institute
IWMI	International Water Management Institute
Megha-LAMP	Meghalaya Livelihoods and Access to Markets Project
NARES	National agricultural research and extension system(s)
NARS	National agricultural research system(s)
NCPP	NGO-community-private partnership
NGO	Non-governmental organization
NRM	Natural resources management
NUS	Neglected and underutilized Species
PC	Planned comparison
PPR	Peste des petits ruminants
PRUNSAR	Putting Research into Use for Nutrition, Sustainable Agriculture and Resilience
RTC	Roots and tuber crops
SDGs	Sustainable Development Goals
SIS	Small indigenous fish species
SOLID	Smallholder Livelihood Development
STRV	Stress-tolerant rice varieties
VC	Value chain

Glossary

Knowledge management
A set of processes, tools and behaviours that connect and motivate people to generate, use and share good practice, learning and expertise to improve IFAD's efficiency, credibility and development effectiveness.

Innovation
A process that adds value or solves a problem in new ways. An idea, product or approach qualifies as an innovation if it is new to a specific context, useful and cost-effective in relation to an intended objective, scalable and sustainable.

Best practices
A method or technique that has been accepted as superior to any alternatives because it produces results that are superior to those achieved by other means.

Lessons learned
Documented information that reflects both the positive (what has worked well) and the negative (what has not worked) experiences of a project or programme throughout the implementation period.

Scaling up
Taking to scale (expanding, replicating, adapting) successful development interventions, policies, approaches and tools in different country or regional contexts to reach a greater number of people in order to increase socio-economic gains, such as improved agricultural productivity, rural incomes and nutrition for greater development impacts on poverty reduction.

Sustainability
The ability of the innovation to continue to generate similar development outcomes over time.

Package or bundles of innovations
This concept, defined by CGIAR as "combinations of interrelated innovations and enabling conditions that, together, can lead to transformation and impact at scale in a specific context",[1] is also used in this catalogue as most of the PRUNSAR projects have promoted several innovations that are often interlinked and contribute to enhancing their outcomes.

1 CGIAR. 2022. *Birds eye view of CGIAR's Innovation Packages and Scaling Readiness (IPSR). https://www.cgiar.org/news-events/news/birds-eye-view-of-cgiars-innovation-packages-and-scaling-readiness-ipsr/*

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1. Introduction

1.1 Background

Agricultural research and innovations that focus on human well-being, inclusion, environmental sustainability and rural development urgently need to be applied at scale to deliver nutritious food sustainably and achieve the Sustainable Development Goals (SDGs). Agrifood systems have become less effective at their primary objective: delivering nutritious food sustainably.[1] Agriculture has historically focused on productivity at the expense of human and environmental health. As a result, food systems account for a third of total greenhouse gas emissions and are the primary driver of freshwater consumption and biodiversity loss globally. Furthermore, as access to processed goods has spread around the world, obesity and other non-communicable diseases have reached record highs, with 3.1 billion people unable to afford a healthy diet in 2021. Rural people and smallholder farmers, who feed an estimated 70 per cent of the world, are suffering the most from the climate crisis and malnutrition crisis, both driven in part by ineffective food systems. With such innovations implemented at scale, agriculture, forestry and fishery sectors can play a key role in tackling food insecurity, malnutrition, environmental degradation and climate change.

1 IFAD. 2021. *Rural Development Report*. https://www.ifad.org/en/rural-development-report/

The European Union (EU) and IFAD co-financed the agricultural research for development (AR4D) programme *Putting Research into Use for Nutrition, Sustainable Agriculture and Resilience* (PRUNSAR), which comprises 13 projects implemented by eight CGIAR centres[2] and the International Network for Bamboo and Rattan (INBAR). From 2015 to 2023, these 13 PRUNSAR projects conducted agricultural research centered around improving nutrition, food security, climate resilience and incomes for smallholder farmers. The programme's overall objective was to **put research into use at scale** in sustainable agricultural systems with large potential impacts on nutrition and resilience. It developed and tested innovative approaches and technical innovations, and generated positive results and lessons for scale-up.

PRUNSAR achieved its objectives to put research into use at scale in sustainable agricultural systems with large potential impacts on nutrition and resilience

- At least **319,000 smallholder producer households in 30 countries** received advisory services, participated in co-creation, testing and validation innovative solutions, and used new approaches or technologies *(target: at least 150,000)*
- At least **40 pieces of evidence** proving adoption of new practices leading to improved food security or nutritional outcomes were produced *(target: at least 10)*
- At least **126 approaches or new technologies** were scaled up (or ready for scale-up) by national systems *(target: at least 10)*
- At least **9 food groups** were introduced to target populations (target: 3) and **5 biofortified crops** were promoted *(target: at least 1)*
- At least **266 publications** were produced

2 Africa Rice Center (AfricaRice), International Livestock Research Institute (ILRI), International Potato Centre (CIP), International Rice Research Institute (IRRI), International Water Management Institute (IWMI), The Alliance of Bioversity International and CIAT, World Agroforestry (ICRAF) and WorldFish.

For each of the 13 PRUNSAR projects, this Catalogue presents: (i) the challenge(s) that require an innovative approach/solution(s); (ii) the innovative approaches and the technical innovations scaled; (iii) the benefits for users, particularly smallholders/rural communities and as relevant to the national agricultural research and extension system (NARES) supporting the introduction and scaling up of the innovations; and (iv) lessons learned/scalability and sustainability prospects. Key resources and contacts are provided for users who would like to know more about the innovations presented.

IFAD defines innovation as a new process, product or approach that adds value and delivers a sustainable, equitable, inclusive and/or new contextual solution to rural development challenges. The innovations in this Catalogue can be broadly placed into one of two categories:

- **Technical innovations,** for example climate-smart agriculture (CSA) technologies and practices, including more productive, sustainable and resilient crops, trees, livestock, fish breeds, intercropping in specific contexts, soil and water management; and ICT-based tools and digital platforms.
- **Innovative approaches,** for example innovative scientific or research methods that centre farmers' perspectives; and leveraging partnerships with loan investment projects.

1.2 About the catalogue

The main innovative approaches and technical innovations that have been generated and promoted by the 13 PRUNSAR agricultural projects implemented in 30 countries across Africa, Asia and Latin America, and that are ready to be scaled up, are presented in this catalogue. These innovations cover a wide range of thematic topics, which contribute to CSA with the aim of sustainably increasing agricultural productivity and incomes, adapting and building resilience to climate change, and reducing greenhouse gas emissions.

The key target audiences for this catalogue are IFAD and partner organizations' staff involved in project design and implementation, particularly projects that target the same areas as PRUNSAR (e.g. aquaculture, rice management and rice supply chains, CSA in East and West Africa, nutrition in East Africa, crop livestock interventions, neglected and underutilized species (NUS), bamboo, peste des petits ruminants (PPR), root and tuber crops (RTCs) in Asia, flood based resource management and more).

The ultimate beneficiaries of the innovations include food-insecure farmers, youth, women and other rural people in regions and countries with acute and chronic poverty, food insecurity and malnutrition. At the end of the PRUNSAR programme, IFAD estimates that more than 319,000 people have benefited from these innovations. However, the indirect and long term impact of the programme is likely to be much greater and has the potential to be even more important as scaling up is achieved by the development of public goods, knowledge products (including this catalogue), technologies, services, policies or a combination of these factors.

1.3 Objectives of the catalogue

This catalogue of innovations showcases and facilitates knowledge sharing on the innovative approaches and technologies developed and successfully implemented by the PRUNSAR projects. It offers new practical solutions and approaches, evidence-based information and lessons for guiding agricultural development practitioners in ongoing interventions and new investments. It can be used to guide governments, private sector entities, and bilateral and multilateral donors to shape their response to the challenges constraining smallholder agriculture and food systems.

The users of the innovations presented in this catalogue include smallholder producers and their communities, and micro, small and medium-sized enterprises. Other users include NARES from the public and private sectors who may require capacity-building on the innovations generated by international agricultural research centres, given their fundamental roles in promoting, scaling up and contextualizing innovations as needed, by training the end-users and considering their feedback and integration of local knowledge to refine innovations as necessary. Such participatory approaches are key for buy-in and adoption by stakeholders.

3. The innovations

3.1 How to use the catalogue

The key innovations generated and promoted by each project implemented under PRUNSAR are presented in this section. Section 3.2 provides an overview of the main challenges addressed and key innovations promoted by each project, examples of key results, lessons learned and scale-up potential. These are discussed in more detail in the subsequent section containing the projects' innovation fact sheets.

3.2 PRUNSAR project innovations at a glance

The innovations (novel approaches or technical innovations) promoted by PRUNSAR projects can be classified using the following main categories (as illustrated in table 1 and presented in the projects' individual innovation factsheets). These innovations were introduced and scaled as part of a bundle or package of complementary innovations that work in synergy to enhance projects' outcomes and to better achieve their goals:

A. **Research in development with farmers and ICT-based tools through interactive innovation co-creation and co-learning models** for scaling natural resources management (NRM) and climate change (CC) adaptation and mitigation solutions, enhancing agricultural production and value chains (APVC) and human and socio-economic capital

B. **Innovative integrated agroecological approaches**[6] to improve nutrition, APVC, NRM, and human and socio-economic capital

C. **Innovations for more productive and healthier plants and animals** through research, enhancement of human and social capital, policy engagement to prevent and control diseases, and a holistic "one health"[7] approach

D. **Innovative partnerships and networks** to improve APVC, NRM, CC adaptation and mitigation, and enhance human and social capital and rural areas.

This categorization reflects the components or pillars of the IFAD Strategic Objectives[8] to which innovations contribute to improve the performance of agrifood systems: (i) the **APVC** component, which includes production, processing, marketing and consumption; (ii) **the socio-economic component or pillar**, which includes human, social and economic capital; (iii) the natural pillar, which covers NRM and CC; and (iv) **the governance component or pillar**, which includes policy and regulatory frameworks and project implementation procedures and approaches, covering innovative partnerships and synergies in considering operating contexts and approaches, as emphasized in the 2020 IFAD corporate-level evaluation report.[9]

6 PRUNSAR projects systematically promoted integrating, protecting and enhancing biodiversity by fostering agroecology and agroecological systems. "Agroecological systems are created by integrating a diversity of crops and animals that allows for recycling of nutrients, water, biomass and energy, and significantly reduces or avoids the use of synthetic pesticides, fertilizers, antibiotics and growth promotors. The costs of these inputs are thus reduced, while the need and cost for labour may increase, creating employment opportunities. Adverse impacts on human and environmental health are avoided and benefits for biodiversity and ecosystem services are maximized." (IFAD. 2021. *Stock-take report on agroecology in IFAD operations: An integrated approach to sustainable food systems.* https://www.ifad.org/documents/38714170/45258342/PMI+Agroecology+assessment.pdf/d39e37dd-8c35-c909-669d-906bb3ad716f?t=1649164401038)

7 "One Health is an integrated, unifying approach that aims to sustainably balance and optimize the health of people, animals and ecosystems". Source: WHO. One health. https://www.who.int/health-topics/one-health#tab=tab_1

8 IFAD. 2016. Strategic Framework. https://www.ifad.org/en/strategic-framework

9 IFAD. 2020. Corporate-level evaluation. *IFAD's support to innovations for inclusive and sustainable smallholder agriculture.* https://www.ifad.org/documents/38714182/41125821/IFAD-CLE2020-COMPLETE-01.pdf/af251dad-10bd-5e80-3fae-a97a82f2059e

These categories also reflect the **five priority areas for agricultural research and innovation** of the EU agricultural research and innovation strategy[10]: **(i) resource management** – notably soil, water, nutrients and genetic resources, where the aim is to strike a balance between productivity and environmental goals in agriculture through efficient resource use; **(ii) healthier plants and animals** – involving research on tools to prevent and control pests and diseases and a holistic one health approach; **(iii) integrated ecological approaches** (agroecological approaches) – for example, research into better use of ecosystem services instead of external inputs and developing specific farming systems such as organic and mixed farming systems; **(iv) new openings for rural growth** – involving the deployment of new business models, circular value chains and digital transformation to sustain and boost rural economies; and **(v) enhancing the human and social capital and rural areas** through innovation networks, advisory services and demonstration sites in rural areas.

A key feature of the approaches used for promoting and scaling the innovations included fostering an **"interactive innovation model"** (rather than a linear innovation model). The building blocks for innovation come from science or from practice and intermediaries, including farmers, advisors, non-governmental organizations (NGOs) and businesses, as actors in a bottom-up process of **knowledge and innovation co-creation**.[11]

© INBAR

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10 European Parliament. 2019. *EU agricultural research and innovation.* Briefing. https://www.europarl.europa.eu/RegData/etudes/BRIE/2019/630358/EPRS_BRI(2019)630358_EN.pdf

11 C. Détang-Dessendre, F. Geerling-Eiff, H. Guyomard and K. Poppe. 2018. *EU Agriculture and innovation: What role for the CAP?* INRA and WUR. Cited in European Parliament. 2019. EU agricultural research and innovation.

Table 1. **Categories of innovations promoted by the PRUNSAR projects**

Research institutions – PRUNSAR project Main innovations

CATEGORY 1

Research in development with farmers and ICT-based tools through interactive innovation co-creation and co-learning models for scaling NRM and CC solutions, and enhancing APVC and human and socio-economic capital

A. ICRAF – Restoration of degraded land for food security and poverty reduction in East Africa and the Sahel: taking successes in land restoration to scale

COUNTRIES: Ethiopia, Kenya, Mali, Niger and United Republic of Tanzania

Farmer-centred approaches that foster adoption of technical innovations at scale, including:

- Research in Development approach to embed co-learning within the development process
- Options-By-Context approach to ensure innovations are locally relevant and widely applicable
- Planned Comparison (PC) approach to test different restoration options with farmers
- Nested communities of practice (COPs) to ensure rapid and effective communication between all stakeholders in the research process.

B. IRRI – Improved crop management and strengthened seed supply system for drought-prone rain-fed lowlands in South Asia

COUNTRIES: Bangladesh, India and Nepal

- Promotion of new stress-tolerant rice varieties (STRVs) and drought-tolerant varieties (DTVs) combined with improved crop management practices (e.g. bio-pesticide and biofertilizer)
- GIS mapping and satellite imaging to target the scaling of STRVs and DTVs
- Mobile Rice Doctor and SeedCast apps to improve crop management and better link supply and demand for seeds of improved and resilient rice varieties.

C. The Alliance of Bioversity International and CIAT – Building livelihoods and resilience to climate change in East and West Africa: AR4D for large-scale implementation of Climate-Smart Agriculture (CCAFS)

COUNTRIES: Ethiopia, Mali, Niger and Senegal

- The Ethiopian Digital AgroClimate Advisory Platform (EDACaP), serving 60,000 extension agents and 16 million farmers
- A partnership with a large radio broadcasting company to disseminate CSA and CIS
- Public-private partnerships with agricultural service providers such as AgCelerant and Hello Tractor
- The CSA prioritization framework to prioritize CSA practices and VCs in specific contexts.

D. AfricaRice – Sustainable and diversified rice-based farming systems

COUNTRIES: Nigeria, Rwanda and Senegal *(Côte d'Ivoire for some technology development/testing)*

- The Android-based RiceAdvice and WeedManager apps, combined with good agricultural practices for rice (GAP)
- Options to diversify rice farming systems with horticulture crops to improve nutrition and income.

CATEGORY 2

Innovative integrated agroecological approaches to improve nutrition, APVC, NRM, and human and socio-economic capital

E. ICRAF – Food trees for diversified diets, improved nutrition and better livelihoods for smallholders in East Africa

Countries: Kenya and Uganda

- Food tree and crop portfolios to address malnutrition due to nutrient gaps by identifying and promoting context-tailored, nutrient-rich food tree and crop species.

F. ILRI – Improved productivity through crop-livestock interventions in eastern Democratic Republic of the Congo and Burundi (CLiP)

Countries: Burundi and Democratic Republic of the Congo

- Crop-livestock packages and agroecological approaches to increase soil fertility and productivity
- Centres for Agri-enterprises and Agro Services (CAAS) to support women- and youth-led enterprises and employment.

G. WorldFish – Managing aquatic agricultural systems to improve nutrition and livelihoods in selected Asian and African countries: scaling learning from an IFAD-WorldFish collaboration in Bangladesh

Countries: Cambodia and Zambia

- Pond polyculture
- Integration of fish-cropping systems
- Community fish refuge systems in wetlands and seasonal flood plains to improve the productivity of rice field fisheries.

H. Bioversity International – Linking agrobiodiversity value chains, climate adaptation and nutrition: empowering the poor to manage risk

Countries: Guatemala, India and Mali

- Holistic value chain and community-based approaches, including community seed banks, networks of farmers using community biodiversity management, biodiversity field fora and seed fairs
- Innovative partnerships to strengthen market access, including with the gastronomy sector and educational institutions (school meals).

I. INBAR – South-South knowledge transfer strategies for scaling up pro-poor bamboo livelihoods, income generation and employment creation, and environmental management in Africa

Countries: Ethiopia, Madagascar and United Republic of Tanzania

- Bamboo biomass and waste processing to create clean energy, and bamboo charcoal production
- Bamboo leaf harvesting and processing to create animal feed
- Household-centred approaches for bamboo production to improve land restoration, soil fertilty and protection against erosion
- NGO-community-private partnership (NCPP) inclusive enterprise model to improve livelhoods.

CATEGORY 3

Innovations for more productive and healthier plants and animals through research, enhancement of human and social capital, policy engagement to prevent and control diseases and a holistic one health[12] approach

J. WorldFish – Improving the technological foundations for sustainable aquaculture

Countries: Bangladesh, Egypt, Malaysia and Timor-Leste

- Development, multiplication and dissemination of high-quality aquaculture strains, notably Genetically Improved Farmed Tilapia (GIFT), to improve aquaculture productivity.

K. ILRI – Control of peste des petits ruminants (ECO-PPR) in Eastern and Western Africa

Countries: Burkina Faso, Ethiopia, Kenya, Mali, Rwanda, Senegal and United Republic of Tanzania

- Thermotolerant PPR vaccines
- PPR surveillance and control toolkits
- Social Accounting Matrix tool for analysing impacts of PPR and informing policy options at national level
- Disease risk mapping for geographic targeting.

CATEGORY 4

Innovative partnerships and networks to improve APVC, NRM and CC and enhancing human and social capital and rural areas

L. CIP – Food resilience through root and tuber crops in upland and coastal communities of the Asia-Pacific (FOODSTART+)

Countries: India, Indonesia, Philippines and Viet Nam

- Promotion of climate-resilient and nutrient-rich, dual-purpose (food and feed) RTCs
- Innovative partnership models to scale up technical innovations
- GIS suitability transformational maps to project where RTCs are likely to replace cereals due to climate change.

M. IWMI – Africa to Asia – Testing adaptation in flood-based resource management

Countries: Ethiopia, Kenya, Malawi, Pakistan, Uganda and Yemen

- Integrated approaches for establishing and strengthening farmer and knowledge networks
- Capacity-building through horizontal learning supporting higher education programmes.

12 "One Health is an integrated, unifying approach that aims to sustainably balance and optimize the health of people, animals and ecosystems". (Source: WHO. One health. https://www.who.int/health-topics/one-health)

3.3 PRUNSAR innovation factsheets

This section presents fact sheets for each of the 13 projects implemented under PRUNSAR, highlighting the main innovations (innovative approaches and technical innovations) used and promoted by each project. Each fact sheet contains: (i) the title of the project and the implementing organization; (ii) an overview of the issues tackled by the project; (iii) a description of the innovations used and promoted; (iv) the benefits for rural communities and the NARES who support the introduction and scaling up of the innovations; (v) lessons learned; (vi) scalability and sustainability prospects; (vii) relevant resources; and (viii) contacts.

Note that the fact sheets focus on selected innovations that have potential for scaling up and/or out with the required adaptation to new contexts (as needed), among a set of innovations that the projects may have implemented to enhance their outcomes.

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Catalogue of Innovations

CATEGORY 1


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Research in development with farmers and ICT-based tools through interactive innovation co-creation and co-learning models for scaling NRM and CC adaptation and mitigation solutions, enhancing agricultural production and value chains and human and socio-economic capital

A | Innovations to take successes in land restoration to scale in East Africa and the Sahel – ICRAF

PROJECT TITLE

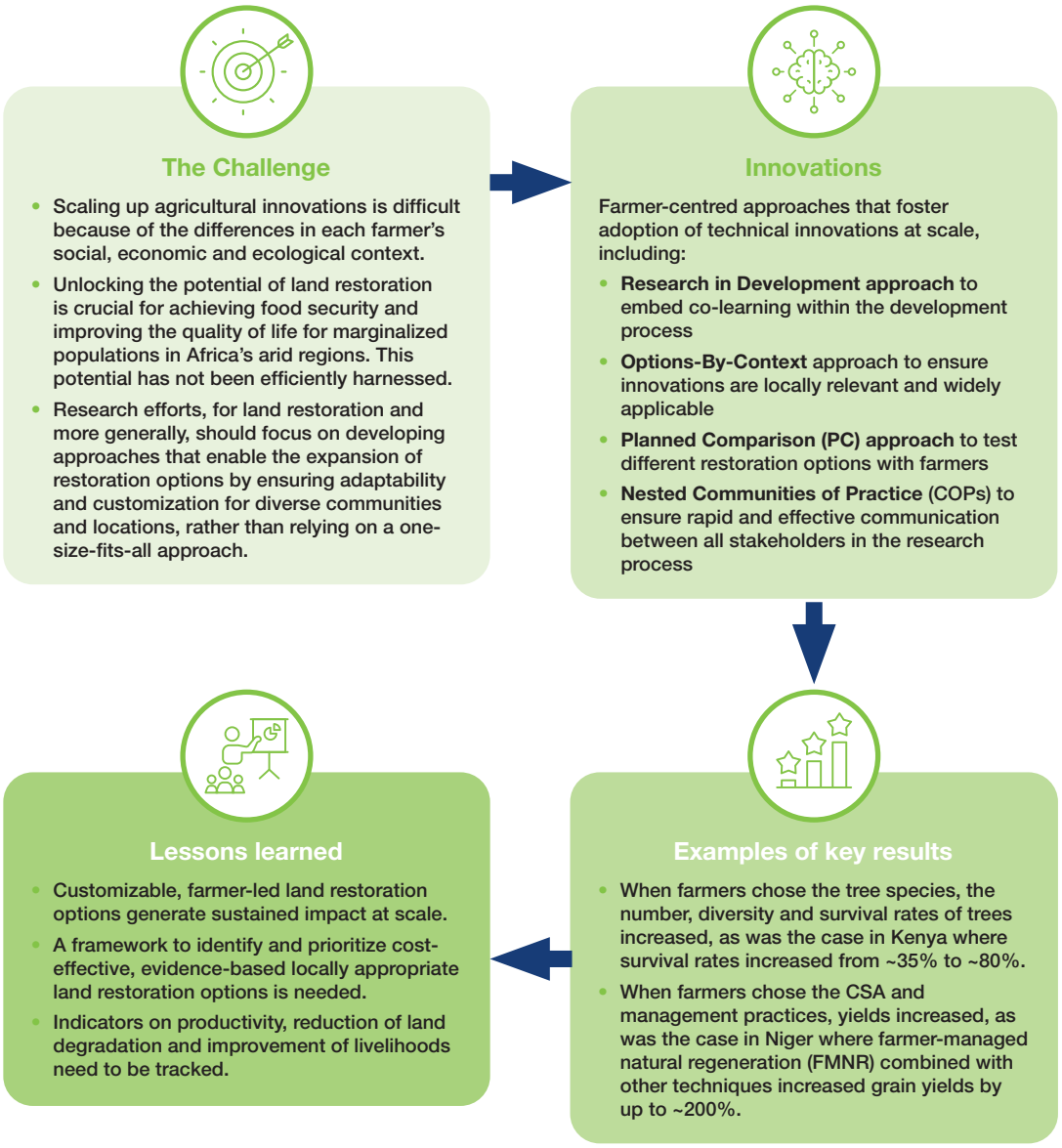
Restoration of degraded land for food security and poverty reduction in East Africa and the Sahel: taking successes in land restoration to scale

COUNTRIES

Ethiopia, Kenya, Mali, Niger (2015-2020)

IMPLEMENTING INSTITUTION

World Agroforestry



Overview

A key constraint to scaling up agricultural innovations is the fact that the ecological, economic, sociological and institutional context varies from household to household. While the reasons for poor adoption are many, there is no silver bullet. **Locally relevant restoration options that will work for different people in different places are urgently needed.** Therefore, this project used and promoted innovative farmer-centred approaches to scale up land restoration techniques and practices that constitute innovations to the target populations (as described below and in the resources provided for more information), to achieve its goal of reducing food insecurity and improving the livelihoods of people living in African drylands by restoring degraded land and returning it to effective and sustainable tree, crop and livestock production systems, thereby increasing land profitability and landscape and livelihood resilience.

The innovations

The project developed innovative ways to achieve scaling of land restoration techniques and practices through a co-learning approach that accelerates the development impact by embedding research in, for example, methods to document and monitor the experiences of farmers and then adapt the technologies to local contexts. The research developed a model that operates through engagement with key development partners, including IFAD country programmes, NGOs, EU country programmes, governments, universities and the private sector. By monitoring interactions among research and development partners, the innovation tracked the way research results and tools were used by stakeholders. Such dialogues, which take place through nested communities of practice, help development actors and researchers understand each other's needs and expectations and facilitate the generation of timely research outputs that can be incorporated into the development cycles.

The farmer-centred approaches – **Research in Development, Options-By-Context, Planned Comparisons (PCs) and nested communities of practices (COPs)** – foster adoption at scale of the technical innovations that work best for each group of target farmers in specific contexts. The **land restoration techniques and practices** promoted included agroforestry and tree planting, farmer-managed natural regeneration, community-based rangeland management, pasture management/exclosure productivity improvement, communal *kallo* improvement (augmented bush-thinning), pest control, planting basins, soil-water conservation measures, short duration and re-seedling, micro-dosing of inorganic fertilizers and manure, and planting basins with manure. The farmer-centred approach and land restoration techniques promoted in the project's implementation sites form **specific bundles or packages of innovations** that enhance the outcomes (**figure 1**).

Benefits to rural communities

In Kenya, agroforestry and tree planting PCs that considered smallholder farmers' preferences based on their needs, constraints and specific contexts resulted in **increased tree cover and species diversity** (13 species compared with 7 initially), a **significant increase in tree survival for the seedlings planted** (from around 35 per cent to around 80 per cent in 2019); **successful planting and growing of over 50,000 trees**, which constitutes a **three-fold increase in tree cover** (from 1-3 to ~9) and tree diversity at farm level, and a significant contribution to Kenya's 2019 "National strategy for achieving and maintaining over 10 per cent tree cover by 2022". The project increased household (HH) income through the sale of tree products and provided HHs with access to improved nutrition from the high-value fruit trees. In addition, maize and legume yields were two to five times higher in planting basins than they were for control farms. Cowpea yields increased from two to over four times higher than controls. Farmers reported increased food security and income due to the higher yields.

Initial results from the participatory gender assessment suggest changes are occurring in HH decision-making and labour patterns. Women have become increasingly involved in farm management decisions, and they participate in development projects and agricultural training.

In Niger, evaluation of a farmer-managed natural regeneration scheme, coupled with micro-dosing of organic and inorganic fertilizer within legume intercropping, led to an increase in grain yields of between 30 and 48 per cent. Scaling up bio-reclamation of degraded lands in Niger aimed to convert degraded crusted soils into productive lands to improve food production and reclaimed 175 hectares of degraded land.

Figure 1: The co-learning process of implementing planned comparisons on the ground

Source: Adapted from ICRAF. 2020. Planned Comparison. https://regreeningafrica.org/wp-content/uploads/2020/01/Planned-Comparisons-2020_Land-Restoration-Full-Brief_compressed.pdf

In Mali, production of grafted fruits is contributing to HH nutrition and increased income from fruit sales in local markets. The use of fertilizer micro-dosing and earth banks has doubled crop yields and increased HH incomes by 40 per cent. These households are now able to meet their cereal food requirements throughout the year.

In Niger, intercropping millet with legumes increased millet grain yields between 30 and 48% compared with the pure millet stand at Zinder and Tillaberi. **However, the application of manure and micro-dosing of fertilizer increased yield ~200%** and biomass ~150%**. In 2018, the planned comparisons were modified to meet farmers' needs and scaled to 1,200 households and included FMNR. Compared to farmers' practice, the application of FMNR increased millet grain yields by 140%. The combined application of FMNR and micro-dosing mineral fertilizer associated with manure produced the highest yields across all five regions. Given the lack of mineral fertilizer, which is a real constraint for small farmers, the application of FMNR with micro-dosing of small quantities of manure in millet/cowpea intercropping systems could be an alternative.**

Lessons learned

Nested COPs capitalize on the multiple learning opportunities across stakeholder groups and thus increase uptake of information and interventions. Key elements of the communities are structured facilitation and documentation, which allow for effective sharing, sustainability and the scaling up of options, while also providing valuable insights that can be adapted for project management.

On-farm workshops with farmers provide a more congenial co-learning environment than traditional workshop facilities at hotels. The importance of closing the learning loop to keep information and evidence flowing across the project is another key lesson from the intervention. This keeps motivation high and ensures sustainability of impact. Another key lesson learned is the importance of research in the development approach to encourage co-learning with evidence.

Scaling up and sustainability

A key consideration for scaling up is the strong engagement of multiple stakeholders, from solution prioritization to evidence generation and interpretation, all of which contribute to the durability of impact. Successful scaling up requires the creation of a framework to identify cost-effective, evidence-based and locally appropriate land restoration options that are visible, measurable and scalable. Such a framework should be able to measure impacts on key indicators, including agricultural productivity, reduction of land degradation and improvement of livelihoods. The evidencing and communication of such impacts is expected to create the necessary political commitment, investment and social momentum to both sustain and further promote the project's customized land restoration options, thereby generating sustained impact at scale.

An uptake survey conducted by the project demonstrated that farmers not engaged in the PC were learning about the basins from farmers engaged. In 2019, some 737 new farming HHs were implementing the planting basins, and reported increased yields. Over 75 per cent of farmers engaged in the planting basin in Kenya expressed excitement to continue to expand the number of basins on their farm. Farmers are reporting increased food security and income from increased yields, and most notably, decreased reliance on food aid.

RESOURCES

ICRAF. 2016. *Guidelines for identifying and designing planned comparisons*. ICRAF Nairobi, Kenya. https://apps.worldagroforestry.org/sites/default/files/outputs/Planned%20comparison%20guidance%20note_VIP4FS_Final_4.pdf

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CATEGORY 1

B | Innovation to improve rice crop management and seed system for drought- and flood-prone rain-fed systems – IRRI

PROJECT TITLE

Improved crop management and strengthened seed supply system for drought-prone rain-fed lowlands in South Asia

COUNTRIES

Bangladesh, India, Nepal (2016-2020)

IMPLEMENTING INSTITUTION

IRRI

Overview

Strengthening seed systems of climate-resistant varieties that respond to the needs of smallholder producers in their specific contexts is fundamental for building resilient cropping systems. The goal of this project was enhanced and stable rice productivity in the drought-prone rain-fed lowlands of South Asia, leading to improved HH food security and reduced poverty. Its objective was to alleviate poverty levels among farmers in rain-fed drought- and flood-prone areas by enhancing and stabilizing rice productivity through the combination of drought-tolerant rice varieties, adoption of improved management technologies, efficient seed supply system and accelerated scaling out.

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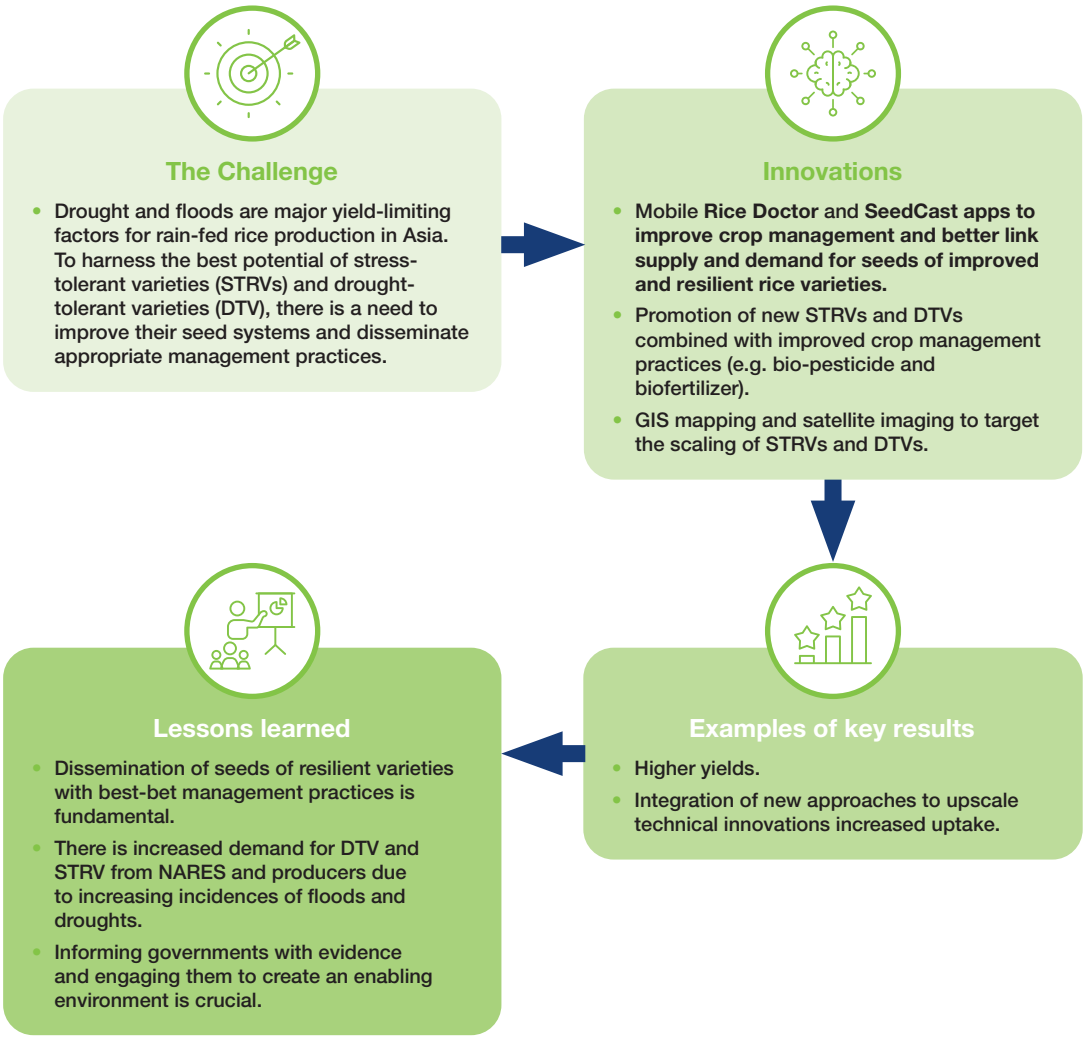

The innovations

The integrated innovations promoted by the project included the following.

Technical innovations and crop management solutions: Improved crop and natural resource management technologies and diversification: new STRVs and DTVs along with improved nutrient-management practices. To further enhance the tolerance of rice DTVs under adverse conditions, microbes such as *Trichoderma* spp. and fluorescent pseudomonads as bio-pesticide and biofertilizer, enhancing root growth and thereby helping the plant to alleviate water stress under drought conditions.

Research approaches and results for guiding promotion of STRVs and DTV to contribute to addressing adaptation to climate change and resilience: Use of GIS and satellite imagery to successfully identify drought- and flood-prone rice areas in South Asia to target the distribution of locally suited rice varieties.

CATEGORY 1

Digitalized tools and platforms: (i) To strengthen the seed chain for many new rice varieties, including the STRVs, the SeedCast mobile application and web portal allows dealers to indicate to seed providers the demand for different varieties of rice seeds (figure 2). Farmers will have access to information on which seeds are available from which dealers, so they can access these for purchase and cultivation according to their needs and environmental conditions. Farmers can also use the application features to take decisions on varietal selection based on their land type and preferences. The information on seed demand is made available to seed corporations, state and district agriculture department authorities. It will help them to produce the preferred seeds in the required quantities. This can reduce the gaps between supply and demand of rice seed varieties and will also encourage the replacement of older, lower-yielding varieties of rice with new, higher-yielding varieties. (ii) The Rice Doctor mobile application for mid-season diagnosis and management of insect pests, diseases, abiotic stresses and agronomic problems helps to provide information on these problems as well as recommendations to address them.

Figure 2: The IRRI SeedCast App to bridge the gap between seed demand and supply and strengthen seed systems

Source: The figure was developed by the Authors; adapted from https://dev-static.irri.org/public/images/Holly%20folder/seedcast_v2.pdf

Benefits to rural communities

Use of STRVs along with location-specific best-bet crop and nutrient management practices were tested, developed and validated to increase rice productivity by 1 to 2 tonnes/ha in rain-fed uplands. For example, DTVs have out-yielded local cultivars and hybrids under drought stress. Cost-effective management options have also been employed for new STRVs in stress-prone environments and have shown high potential for enhancing yields. For example, 21- to 25-day-old seedlings were transplanted with two to three seedlings at closer spacing, while 30-40 kg of seeds/ha were sufficient for direct-seeded rice. Several short-duration, drought-tolerant rice varieties have produced yields **up to 45 per cent higher than popular varieties** in farmers' fields. Different **strategies were used to create awareness and to ensure local availability of quality seeds, including seed multiplication and demonstration, head-to-head trials, seed minikit distribution and a crop cafeteria**. About 84,400 farming HHs have directly benefited from drought-tolerant rice varieties.

GIS mapping was used to successfully identify drought- and flood-prone rice areas in South Asia to target the distribution of locally suited rice varieties. For example, using GIS and satellite images, drought- and flood-prone areas have been characterized in Nepal. In Terai, 917 wards in 8 districts were identified as suitable for dissemination of DTVs (ukhadhan 1 to 5).

To strengthen the local seed supply system, farmer groups and NGOs operating in remote areas are encouraged to produce STRVs. To generate significant direct economic gain to the poor farmers, along with climate resilience, the focus has been **to develop 'seed enterprise models'.** In **Bangladesh**, for example, a seed producers' group in Cox's Bazar Sadar has taken up seed production of climate-resilient rice, linked breeder-seed sources to producers' groups, and provided training to the producers in quality and seed marketing aspects.

Various **capacity-building** measures have been conducted to **strengthen formal and informal seed supply systems for STRVs** and to **promote seed entrepreneurship among stakeholders.** These have included training of trainers, training sessions on quality seed production and storage, and training in quality seed production in Rae Bareli (**India**).

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In addition, research carried out also defined site-specific nutrient management technologies for drought-prone rice-based cropping systems that are ready for scale-up. For example, a dose of 80-100 kg of nitrogen, 60-80 kg of phosphorous and 40-60 kg of potassium per hectare are optimum for these nutrient-responsive varieties. Application of 25 per cent nitrogen from ammonium sulphate, use of neem-coated urea, urea super-granules, application of vesicular-arbuscular mycorrhiza and phosphorous solubilizing bacteria showed marked improvement in the nutrient use efficiencies.

Lessons learned

In collaboration with NARES partners, the **best-bet management practices for the STRVs have been validated and disseminated along with seed of the improved varieties for adoption by farmers.**

Activities were designed to **develop management approaches at the farm level that optimized the growing of DTVs within the complete production system, considering all factors affecting productivity and quality.** Through the project interventions, management practices for DTVs, improved nursery and crop establishment options, direct seeding of rice, integrated weed management for drought-prone areas, system intensification and diversification opportunities with DTVs, were tested, validated and disseminated to the smallholder farmers. Low, inadequate and untimely fertilizer use is a major production constraint that has also been addressed to explore the full yield potential of high-yielding DTVs.

Scaling up and sustainability

According to IRRI, with increasing incidences of floods and droughts in South Asia due to climate change, there was a constant demand from NARES to scale the technologies. The project activities were aligned with different ongoing projects – ICAR-W3, Odisha Government project and APART. Development of site-specific best-bet management practices for newer STRVs in different abiotic stress-prone areas is ongoing. Scaling up these technologies can bring a huge impact through improved resilience and adaptation to climate change.

RESOURCES

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CATEGORY 1

C | Innovative approaches for scaling CSA to build livelihoods and resilience to climate change – The Alliance Bioversity & CIAT

PROJECT TITLE

Building livelihoods and resilience to climate change in East and West Africa: AR4D for large-scale implementation of climate-smart agriculture

COUNTRIES

Ethiopia, Mali, Niger, Senegal (2019-2023)

IMPLEMENTING INSTITUTION

Alliance Bioversity & CIAT

Overview

A combination of innovative approaches and technical innovations are needed to scale up CSA in different contexts. The overall goal of this project was to build livelihoods and improve resilience to climate change among smallholder farmers in East and West Africa through large-scale adoption of CSA technologies and practices. The project had two objectives: (i) To derive new knowledge on scalable CSA technologies and institutional options with demonstrable benefits for women and men farmers, youth employment, climate resilience and low-emission development; and (ii) to engage in ongoing development and private sector initiatives to assist in the prioritization of the best options and in policy development.

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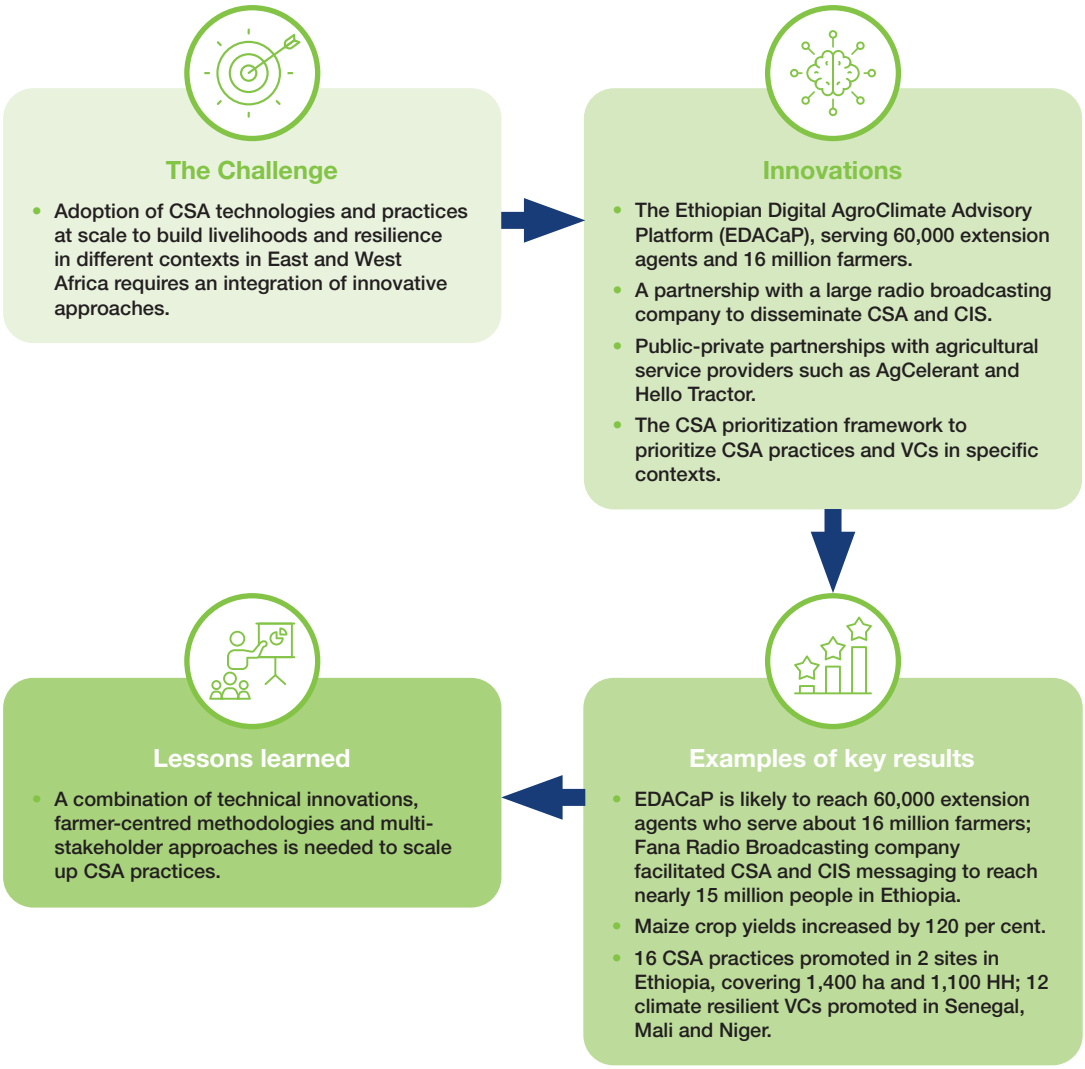

The innovations

The integrated innovations used and promoted by the project include the following.

1. The **Ethiopian Digital AgroClimate Advisory Platform (EDACaP),** the only fully integrated infrastructure supporting the Ethiopian Ministry of Agriculture in developing sub-seasonal and seasonal outlooks and streamlined services. A recent study shows that EDACaP is likely to reach 60,000 extension agents of the Ministry of Agriculture who, in turn, serve about 16 million farmers.

2. The **Evidence for Resilient Agriculture platform is an innovation in data storage and delivery** that is more synthetic, user-oriented and decision-ready than any other agricultural meta-analyses and has been proven by the diversity of cases in which the platform has been used.

3. **Collaboration with Fana Radio Broadcasting company**, an innovative partnership that facilitated CSA and CIS messaging to reach nearly 15 million people in Ethiopia.

4. **agCelerant**, a product of the **Manobi Africa-ICRISAT public-private partnership supported by this project**, which is a smallholder VC orchestrator and the main instrument used by this project to develop climate-smart services involving smallholder value chains.

5. **Conservation tillage using mechanized ripper for improved soil fertility and resilience in collaboration with private sector partner Hello Tractor.** This project promoted the use of climate-smart tractors to improve soil fertility and resilience. The **business model of Hello Tractor in itself is innovative** as it provides mechanization and ripping services to smallholder farmers through a mobile phone app. This conservation tillage is an innovation as it is a climate-smart alternative to conventional disc plough tillage that improves soil fertility and resilience.

Innovative approaches for scaling up technical innovations

1. **CSA prioritization framework approach,** which allowed the identification of 10 key CSA practices.

2. **Multi-stakeholder Innovation Platforms on CSA and VC** established in Mali, Niger and Senegal.

3. **A conceptual framework for climate-smart VC analysis** was developed and is applicable to all countries. Twelve climate-smart priority VCs were identified and validated (in Senegal: groundnut, millet, sorghum, non-timber forest products; in Mali: rice, millet, sorghum, cowpea, vegetables; and in Niger: millet, rice, red meat) by assessing their development risks, vulnerability factors and adaptation options; 23 CSA technologies were identified and used to develop four integrated CSA portfolios.

Benefits to rural communities

Sixteen CSA practices were implemented at two sites in Ethiopia, covering 1,400 ha and 1,100 HHs. By promoting small-scale irrigation for fruits and vegetables, 12 jobs were created for youth with 14 ha of land, which resulted in an income of US$22,000 from selling fruits and vegetables. Studies found that maize yields increased by 120 per cent. Through collaboration with Echnoserve, the project reached 5,000 smallholder farmers via an app used to tailor climate information to agricultural needs.

Stakeholder workshops on risk identification across selected commodities resulted in 12 priority VCs: In Senegal, groundnut, millet, sorghum, non-timber forest products; in Mali, rice, millet, sorghum, cowpea, vegetables; and in Niger, millet, rice and red meat. In addition, two gender studies were conducted to understand linkages between gender and vulnerability.

Enhanced CIS and big data solutions to enhance smallholder production for VC in West Africa: 10 communities were trained to adopt Participatory Integrated Climate Services for Agriculture for VC operations. Smallholder farmers have been assessed in soybean and sorghum VCs in Ghana to identify candidate farms for digital market inclusion.

One hundred agCelerant agents were contracted to stimulate capacity-building, and 10 prototypes of the Internet of Things rain gauges transferred to Kenya and Tanzania.

A range of **climate-smart business models and financing mechanisms** were identified and promoted. These included two CSA investment plans, which have been validated by national partners in Ghana, Mali, Nigeria and Senegal. Four business models to identify best bets for private sector engagement in scaling up CSA, and three climate risk profiles were developed for Tanzania.

Lessons learned

A combination of innovative approaches and technical innovations that address the specificities, needs and constraints of different contexts are needed to ensure scale-up of CSAs, learning from and adapting as appropriate the successful innovations promoted in similar settings with farmer-centred and multi-stakeholder approaches.

Scaling up and sustainability

Different approaches that foster sustainable scale-up were used. These included training on the CSA technologies and practices carried out in 20 climate-smart villages in Mali, Niger and Senegal, and climate-smart village visits organized for VC stakeholders and the EU system institutions in Mali and innovation platform members in Senegal. In Ethiopia, the project is sharing experiences and lessons with projects and initiatives such as Africa RISING, Excellence in Agronomy and Accelerating the Impact of CGIAR Climate Research for Africa.

Engagement with district-level offices and local universities across the country also serves as a springboard to scale up tested technologies. In Kenya, the conservation tillage business model will be taken up by Ukama Ustawi, the One CGIAR East and Southern Africa Regional Integrative Initiative. This will support scaling up through farmer demonstrations on the *Shamba Shape Up* farm makeover TV show, which reaches over 8 million Kenyan viewers every week, and is also linked to the iShamba mobile SMS-based agro-advisory platform and call-in centre with over 500,000 users.

Finally, investment plans developed through this project provide opportunities for IFAD, the EU, and other public and private investors to finance CSA investments.

RESOURCES

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CATEGORY 1

D | Innovative digital ICT tools and integrated approaches to foster sustainable and diversified rice-based farming systems – AfricaRice

PROJECT TITLE

Sustainable and diversified rice-based farming systems

COUNTRIES

Nigeria, Rwanda, Senegal (2018-2023)

IMPLEMENTING INSTITUTION

AfricaRice

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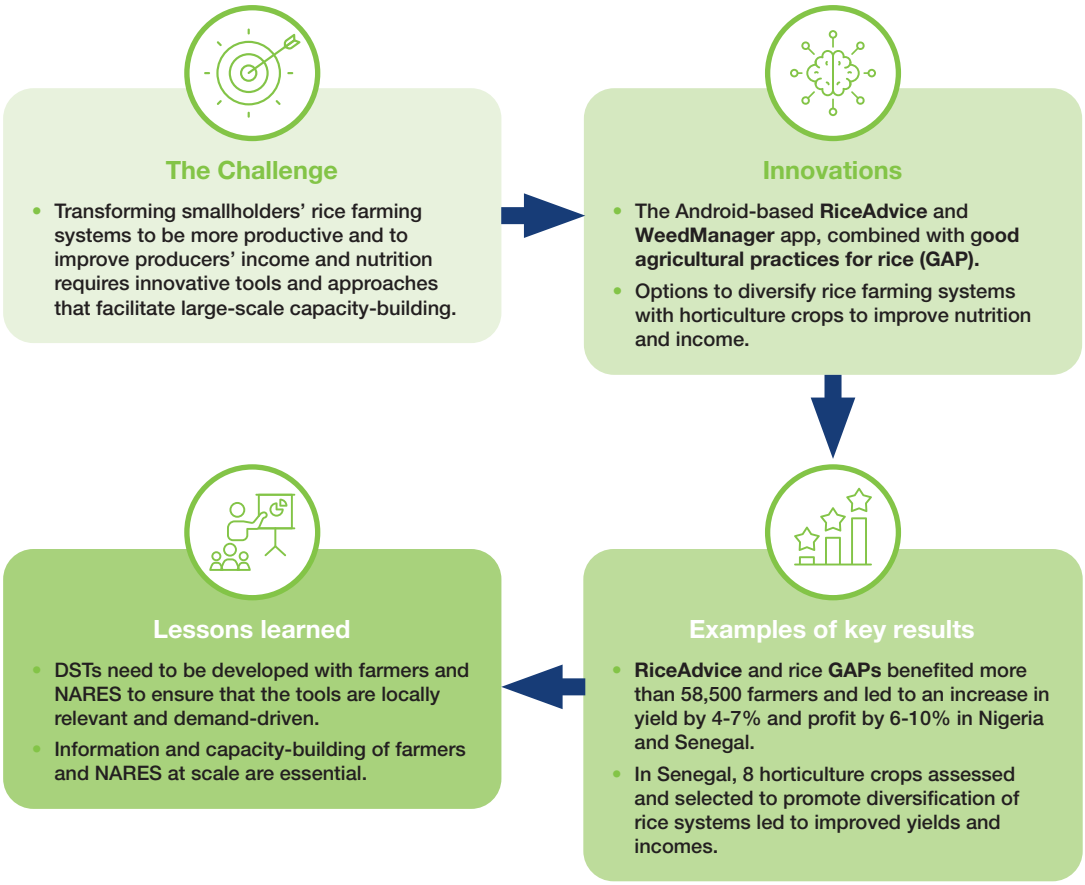


Overview

Rice farming systems need to be transformed to become more sustainable and diversified to improve productivity and smallholders' income and nutrition. AfricaRice's project aimed to sustainably intensify rice-based farming systems while minimizing their environmental footprint and adapting them to climate change, with a specific objective to improve crop management technologies and practices and diversify farming systems.

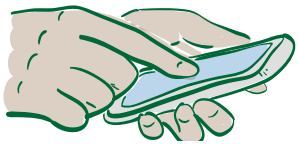
The innovations

AfricaRice developed a set of technical innovations and approaches that included decision support tool (DST) apps, namely the RiceAdvice and RiceAdvice-WeedManager, which were combined with other tools to support extension services such as rice good agricultural practices (figure 3), capacity-building of NARES staff and private service providers, and the final users – the smallholder farmers. In addition, a knowledge platform was developed with a mobile app called "e-chain", which contains a farmer contact directory, technical fact sheets for all rice varieties grown in the Senegal River valley region of Senegal, seed data and market demand, and information for producers and seed dealers on new varieties with market potential, linked to an external climate service provider. Further, business models for scaling the use of RiceAdvice in Nigeria have been developed and tested. Options to diversify rice farms with other crops (mostly horticulture crops) to improve nutrition and income were also assessed in research stations and farmers' fields, which produced various results that are useful to guide producers.

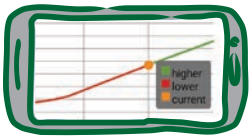
Figure 3: AfricaRice RiceAdvice App Decision Support Tool

- An Android-based app available on Google Play
- Provides customized (field-level) recommendations for fertilizer management (which fertilizers, when and how much), expected crop duration and other good agricultural practices (GAPs)
- Can be adapted to any irrigated or favorable rain-fed lowland in Africa
- 100,000 recommendations generated (end of 2021)
- Increases yield (by 7-20%), profits (by 10-23%) and nutrient use efficiency
- Expected users: Extension agents, private rice VC actors (millers, input dealers, seed producers, machinery service companies, farmer associations) and youth who want to provide the service of providing recommendations for farmers.

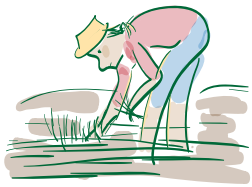
Step 1-2: Download RiceAdvice from Google Play on smartphone or tablet. Read installation and user manual



Step 3: Following discussion between the provider and farmer, fill in farmer's personal farming conditions: Rice-growing conditions, typical practices, expected sowing date, fertilizer availability and market price



Step 4: Set yield targets based on available budget or desired production level



Step 5: Get personalized recommendations, including a crop calendar, fertilizer plan, recommended rice variety and other GAPs

Step 6: Record personalized recommendations for the farmer

Country/location	Nigeria/Kano	Field size (ha)	1
Season	Wet	Target yield (t/ha)	6.5
Variety	FARO 44	Sowing date	2022/06/15
Establishment	Transplanting	Expected seedling age	< 20 days
Rice growth stage	Basal	Tillering	Panicle initiation	Booting
Application timing	At transplanting	31–35 DAS (2022/07/18)	43–47 DAS (2022/07/30)	73–77 DAS
NPK (15–15–15) (kg)	252	0	0	0
Urea (46–0–0) (kg)	0	92	108	0

DAS: Days after sowing; For farmers who do not have a smartphone, the printout would be filled in with the recommendations generated by RiceAdvice.

Step 7: Farmer follows personalized recommendations and applies good agricultural practices. RiceAdvice guideline is effective if GAPs are applied

Source: Adapted from: https://www.africarice.org/_files/ugd/0839e4_2665069444494d459c9180e4db607de4.pdf

Benefits to rural communities

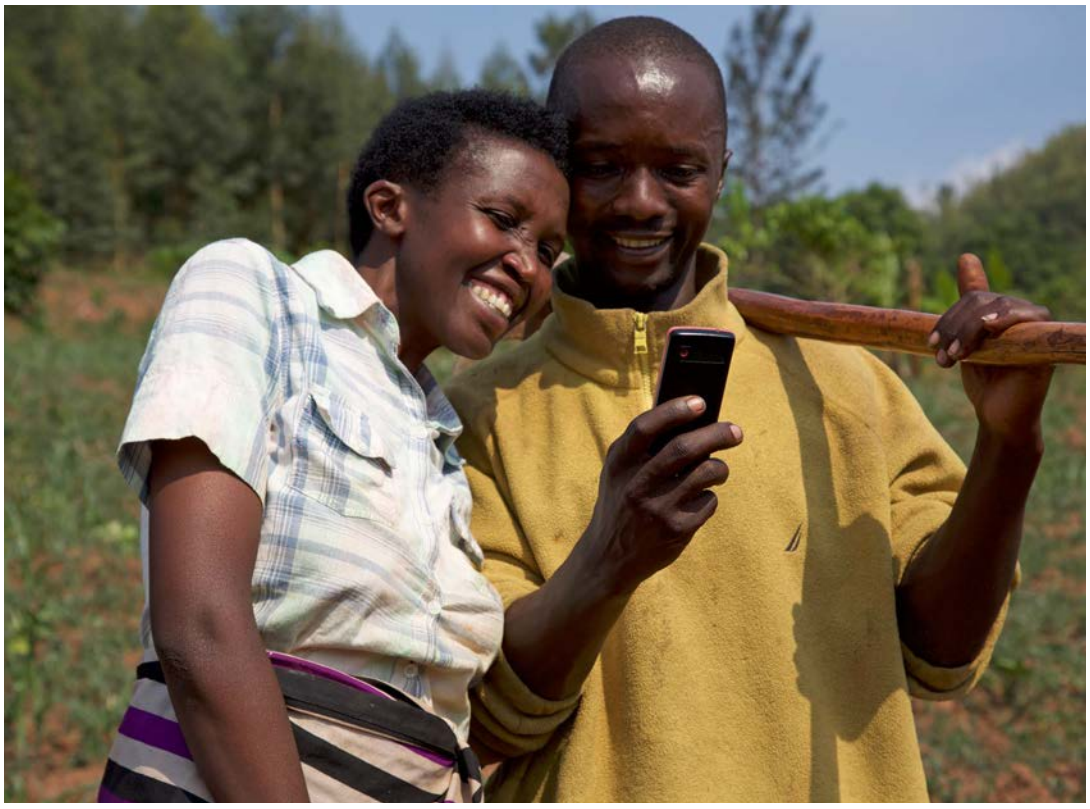
RiceAdvice and GAPs benefited 58,537 farmers. An impact assessment study by AfricaRice highlighted increases in yield by 4-7 per cent and profit increases of 6-10 per cent in Nigeria and Senegal.

Business models (BM) for the RiceAdvice app were identified and validated through participatory approaches in Nigeria based on different payment methods used by producers for extension services: (i) cash payment after harvest at 1,500 Naira per quarter of a hectare (BM1); (ii) cash payment after harvest and charged at the rice price of 3 Naira per 2 kg of paddy (BM2); and (iii) cash at delivery at 1,000 Naira per quarter of a hectare (BM3). The results showed an overall interest in paying, with about 72 per cent acceptance.

The results of a study[13] carried out with 700 producers in Nigeria showed that they are willing to pay US$3-5 per quarter of a hectare to receive personalized advice, which indicates that they value the technology and understand how it can improve efficiency and productivity.

The performance of diversification options under researcher-managed trials in research stations and farmers' fields produced various results that are useful to guide producers. For example, in Senegal, eight promising crops (hot pepper, sweet pepper, tomato, cucumber, eggplant, okra, onion and mung bean) with rice equivalent yield of 12-125 tonnes/ha were assessed and selected. Upland rice-based cropping systems with conservation agriculture were also tested. The results showed that intercropping a semi-perennial legume, such as Stylosanthes, with a long-cycle root crop (e.g. cassava) or a semi-perennial legume (pigeon pea) with a cereal crop (maize) were promising systems in which the cover crop grows for long periods and can enhance productivity of upland rice in the subsequent season.

Results from an on-farm experiment in Senegal also showed that the gross income gain was US$2,804 (229 per cent) in the wet season and US$2,769 (183 per cent) in the dry season compared with sole rice production in the wet and dry seasons, respectively. This indicates the importance of introducing improved vegetable varieties for maximizing income in rice-vegetable cropping systems.



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13 Amoussohoui, R., Arouna, A., Bavorova, M., Tsangari, H. and Banout, J. 2022. An extended Canvas business model: a tool for sustainable technology transfer and adoption. *Technology in Society* 68: 101901. https://doi.org/10.1016/j.techsoc.2022.101901

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To support smallholders' access to improved seeds and seed VCs, in Senegal 1,000 stakeholders, including 250 seed producers, were interviewed and geo-referenced. Information on seed of new varieties, agri-inputs and good agronomic practices, seed traceability and quality control, and production performance and seed availability are stored in the knowledge platform. Information on the seed businesses was also published in the e-chain app.

Lessons learned

DSTs such as RiceAdvice need to be assessed, including feedback from end-users and NARES, to become more efficient and to ensure adoption. The RiceAdvice assessment resulted in the need to improve and simplify some of its functionalities and to include GAPs. It resulted in the development of the improved version, RiceAdvice Lite.

The DSTs need to be linked to an improved digital data collection tool, the Sustainable Rice Platform, to collect information on farmers' sustainable rice cultivation by AfricaRice's partners, and to identify intervention areas for improving sustainability in rice cultivation.

Scaling up and sustainability

Sustainability and scale up of the use of DSTs also require the development of business models that are feasible in the different contexts where they are promoted, proper capacity-building and training of the NARES and farmers, and awareness-building (mass information) along with hands-on training to create demand for these tools. This can be fostered through collaboration with relevant partners, including academia, farmer organizations, development projects, public extension services, the private sector, NGOs, and public research and development, as well as policymakers and donors for fostering an enabling environment.

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CATEGORY 2


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Innovative integrated agroecological approaches[14] to improve nutrition, APVC, NRM, and human and socio-economic capital

E | Innovative approach to improve nutrition: food trees and crop portfolios – ICRAF

PROJECT TITLE

Food trees for diversified diets, improved nutrition and better livelihoods for smallholders in East Africa

COUNTRIES

Kenya, Uganda (2016-2020)

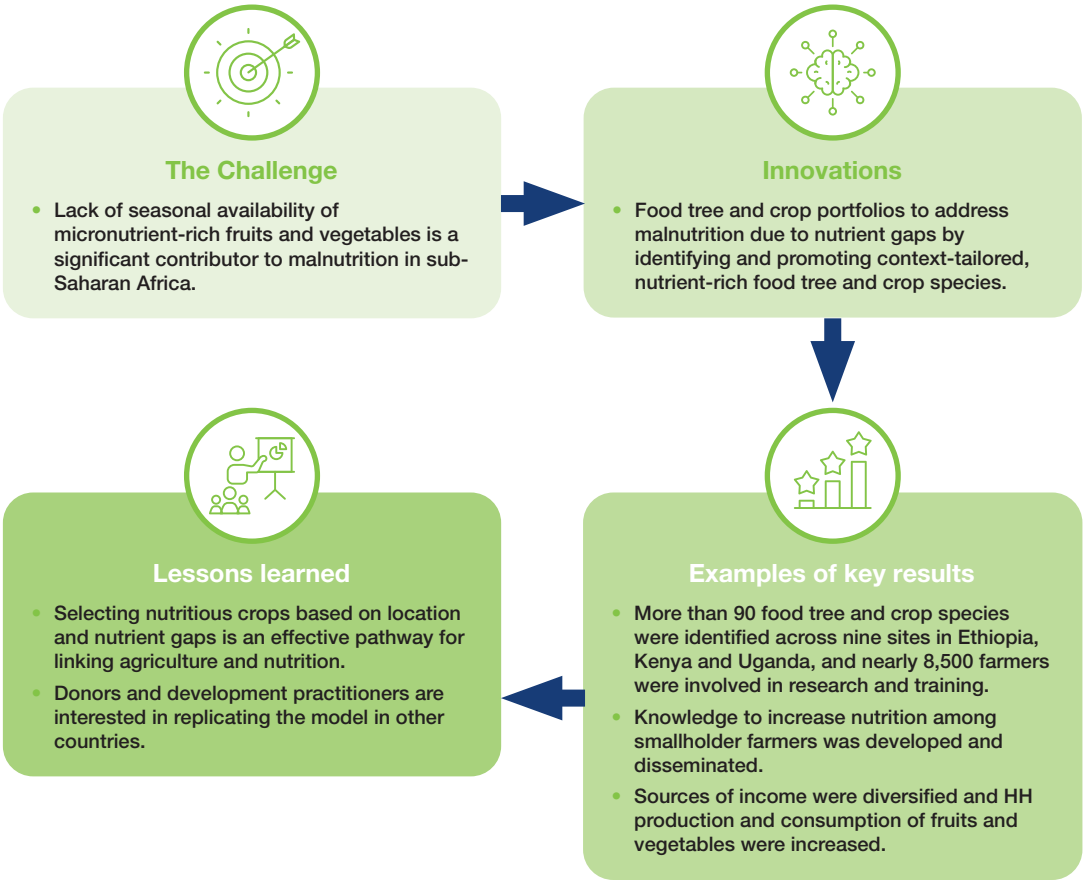
IMPLEMENTING INSTITUTION

World Agroforestry

14 PRUNSAR projects systematically promoted integrating, protecting and enhancing **biodiversity** by fostering **agroecology and agroecological systems.** "**Agroecological systems** are created by **integrating a diversity of crops and animals** that allows for recycling of nutrients, water, biomass and energy, and significantly reduces or avoids the use of synthetic pesticides, fertilizers, antibiotics and growth promotors. The costs of these inputs are thus reduced, while the need and cost for labour may increase, creating employment opportunities. **Adverse impacts on human and environmental health are avoided and benefits for biodiversity and ecosystem services are maximized.**" (IFAD. 2021. Stock-take report on agroecology in IFAD operations: An integrated approach to sustainable food systems. Page 15) https://www.ifad.org/documents/38714170/45258342/PMI+Agroecology+assessment.pdf/d39e37dd-8c35-c909-669d-906bb3ad716f?t=1649164401038

Overview

Malnutrition in all its forms, including under-nutrition, micronutrient deficiency and over-nutrition, affects one in three people worldwide and is a major risk factor in non-communicable disease. The causes of malnutrition are complex, but the primary cause is an inadequately balanced diet. This imbalance is characterized by a limited selection of nutritious foods obtained from food and agriculture systems that prioritize meeting calorie requirements rather than ensuring a diverse intake of essential nutrients.[15] Integration of food trees that provide nutrient-dense foods (fruits and nuts, seeds for protein and oils, leaves as vegetables) into the existing crop farming systems supports diet diversification and achievement of improved nutritional outcomes.



15 FAO, IFAD, UNICEF, WFP and WHO. 2023. The State of Food Security and Nutrition in the World 2023. Urbanization, agrifood systems transformation and healthy diets across the rural–urban continuum. Rome, FAO. https://doi.org/10.4060/cc3017en

The innovations

Lack of seasonal availability of micronutrient-rich fruits and vegetables is among the main reasons for low intake among smallholder farmers in rural sub-Saharan Africa. **To overcome seasonal food and nutrient gaps and diversify predominantly staple-based diets**, World Agroforestry, with support from the EU and IFAD, has developed an **innovative approach for selecting ecologically suitable and nutritionally valuable food tree and crop species for production on farms, known as "Food Tree and Crop Portfolios"(figure 4)**. In addition to filling harvest gaps, the portfolios address certain micronutrient gaps in a site by matching the identified tree foods and crops with food composition data. The approach involves a variety of tools that allow triangulation of data sets. It also provides an example of how agriculture can be used to promote nutritionally rich foods, particularly for rural smallholders who rely predominantly on foods from their own farms.

Benefits to rural communities

- **More than 90 food tree and crop species have been identified across nine sites** in Ethiopia, Kenya and Uganda, with an average of 30 species recommended per portfolio.
- The portfolios not only support direct food production-consumption pathways but also support diversified income-generating pathways through engagement in nursery enterprises for the supply of tree seeds and seedlings, with the potential to sell surplus produce from the prioritized food trees once they fruit.
- Increased HH nutrition and incomes of smallholders through food production diversity are the key benefits from this project. Many HHs can meet their seasonal dietary needs through a combination of their own production on farm and from the market.
- **Nearly 8,500 smallholders were involved in research and outreach activities, particularly in data generation, participatory action research, knowledge exchange events**, cross-site learning visits, and targeted training on cultivation of prioritized food tree and crop species and varieties, and nurseries.
- **Climate suitability modelling was completed for seven priority food tree species:** mango, avocado, papaya, moringa, tamarind, desert date and baobab.

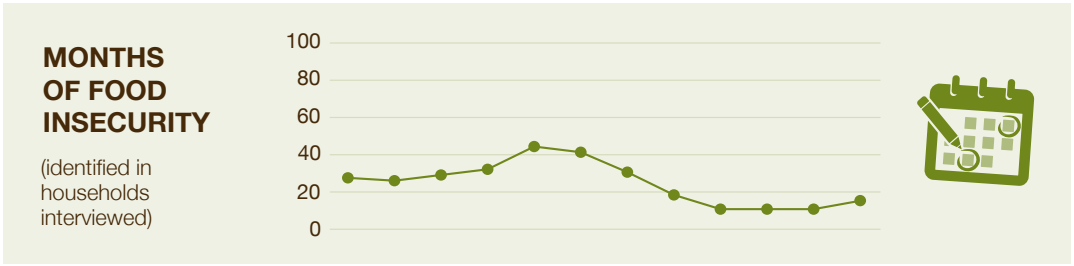
Lessons learned

Using data for evidence-based, nutrition-sensitive agricultural approaches. The portfolio approach makes use of location-specific data not only to capture the socioecological dynamics of smallholder food production diversity but also, uniquely, to include individual food consumption data to inform knowledge on local dietary gaps and decision-making at the country, regional and global levels.

Selecting location-specific species diversity to address seasonal availability. The tools applied need to be flexible enough to develop portfolios for unique sites due to variations in species suitability, phenology and farmers' preferences. It is important to note that the portfolio is a recommendation. **It may not be ideal for a farmer to produce all species included due to land, water and other restrictions.**

Nutrient composition data for linking agriculture and nutrition. Information on the nutrient content of indigenous and underutilized crops is often scarce. As a result, less-researched indigenous and

Figure 4: Kinango (Kwale County, Kenya) nutritious food crops portfolios[16]



	Food Name[a], *Scientific Name*	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	IRON	VITAMIN A[b]	FOLATE	VITAMIN C
FRUITS	COCONUT *Cocos nucifera***1,*1*	■	■	■	■	■	■	■	■	■	■	■	■	++		~	
	BANANA *Musa spp.*	■	■	■	■	■	■	■	■	■	■	■	■			~	~
	PAWPAW/PAPAYA *Carica papaya*	■	■	■	■	■	■	■	■	■	■	■	■	~	++	~	+++
	ANNONA/CUSTARD APPLE *Annona reticulata*					■	■	■	■					~		■	++
	BAOBAB *Adansonia digitata*							■	■	■				+++		~	+++
	MANGO *Mangifera indica***2*	■											■	~	+++	~	++
	ORANGE *Citrus sinensis**2*							■	■							~	+++
	LEMON *Citrus limon**3*							■	■								+++
	GUAVA *Psidium guajava*								■	■				~	~		+++
	TANGERINE *Citrus reticulata*								■	■					~		++
	JACKFRUIT *Artocarpus heterophyllus*									■	■					~	~
	TAMARIND *Tamarindus indica***3*										■	■		++			~
VEGETABLES	WILD LETTUCE *Lactuca virosa***1*	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	PUMPKIN, *leaves* *Cucurbita maxima*	■	■	■	■	■	■	■	■	■	■	■	■	~	++		
	BLACK NIGHTSHADE, *leaves* *Solanum nigrum*3*			■	■	■				■	■	■	■	+++	+++	■	~
	SPINACH *Spinacia oleracea***3,*2*			■	■	■				■	■	■	■	++	+++	++	~
	KALE *Brassica oleracea***2,*1*			■	■	■				■	■	■		~	+++	++	~
STAPLES	MAIZE, *sweet, yellow* *Zea mays***1,*1*	■							■	■			■	~	~		
	SORGHUM *Sorghum bicolor*	■							■	■			■	~			
	SWEET POTATO, *yellow* *Ipomoea batatas*								■	■				~	+++	~	~
	SWEET POTATO, *pale* *Ipomoea batatas*								■	■				~		~	~
	RICE, brown *Oryza sativa***2,*2*								■	■				~			
	RICE, white *Oryza sativa***2,*2*																
PULSES	BEAN *Phaseolus vulgaris**3*	■							■	■			■	~		~	
	MUNG BEAN/GREEN GRAM *Vigna radiata***3,*3*	■							■	■			■	~		++	
	COWPEA *Vigna unguiculata*	■							■	■			■	~		++	
	PIGEON PEA *Cajanus cajan*	■					■	■						++		~	
	CASHEW NUT *Anacardium occidentale*	■	■										■	+++		~	

NOTES:

a Fruits as well as nuts refer to raw foods, whereas staples, pulses and vegetables are represented in their cooked (boiled) form.

b Vitamin A (calculations based on Vitamin A retinol equivalent = retinol + 1/6 beta-carotene + 1/12 alpha-carotene + 1/12 beta-cryptoxanthin). Data are expressed per 100g fresh weight of edible portion.

* most sold

** most consumed

[1,2,3] as prioritized by farmers (staples and pulses considered together)

KEY:

+++ high source	not a source
++ source	no data available
~ present, but low source	

16 World Agroforestry. Nutritious food prtfolios for targeting year-round harvest and nutrient gaps. https://apps.worldagroforestry.org/downloads/Publications/PDFS/LE19082.pdf

underutilized crops rich in micronutrients may be overlooked in agriculture and nutrition development planning and policies.

Beyond food production-consumption pathways. The portfolio approach provides a suitable entry point for promoting a direct production-consumption pathway to address more food consumption and dietary needs but should be combined with awareness campaigns on healthier diets.

Production diversity, particularly of perishable foods, such as fruits, plays a crucial role. This is especially the case where infrastructure market connectivity is limited, as it supplies local markets and provides nutritious and accessible foods to local communities.

Scaling up and sustainability

- The location-specific portfolios have been developed and communicated to the beneficiary communities and supporting national partners. The project itself has supported the development of locally relevant communication materials to effectively transfer this information, undertaken training with individual farmers and farmer groups, and held open days to reach wider numbers in the communities with which the project operates.
- To ensure sustainability, lead farmers, farmer groups, nursery businesses and schools have been engaged in establishing demonstration plots for the portfolios, received technical training and information on their establishment, and managed portfolios and subsequent information on the value of production diversity to meet seasonal food, nutrition and income needs.
- To ensure knowledge-sharing and scaling up, the project has engaged in a number of county open days to promote and explain the project's purpose, activities and impact.
- Through the various communication tools and training modules delivered by the project, the portfolio approach has been disseminated to target project beneficiaries, wider community members and local partners.

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- The portfolio approach can be adapted to different locations with diverse agroecological conditions, as illustrated by the diverse environments of project sites in Ethiopia, Kenya and Uganda.
- Other donors and implementing partners have shown interest in replicating this innovation across other countries. A user guide and several papers have been published for interested partners.
- The project **partnered with Kenya Agricultural and Livestock Research Organization** for the propagation and multiplication of 15 prioritized food tree species (25 varieties) and over 10,000 seedlings were distributed.
- **Two novel food tree products were developed in collaboration with Jomo Kenyatta University of Agriculture and Technology** – a probiotic mango beverage and dried mango-tamarind fruit bars/leathers from two prioritized food trees.

RESOURCES

IFAD. 2020. Catalogue of innovations. pp 68-71. https://www.ifad.org/en/web/knowledge/-/publication/innovation-catalogue

ICRAF. 2020. Final report of the project 'Food trees for diversified diets, improved nutrition, and better livelihoods for smallholders in East Africa under the PRUNSAR programme'. http://www.worldagroforestry.org/project/food-trees-diversified-diets-improved-nutrition-and-better-livelihoods-smallholders-east

All outputs produced by project are available on the project website.

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CATEGORY 2

F | Innovations to improve productivity of crop-livestock systems and livelihoods – ILRI

PROJECT TITLE

Improved productivity through crop-livestock interventions in eastern DR Congo and Burundi (CLiP)

COUNTRIES

Burundi, Democratic Republic of the Congo (2015–2019)

IMPLEMENTING INSTITUTION

ILRI

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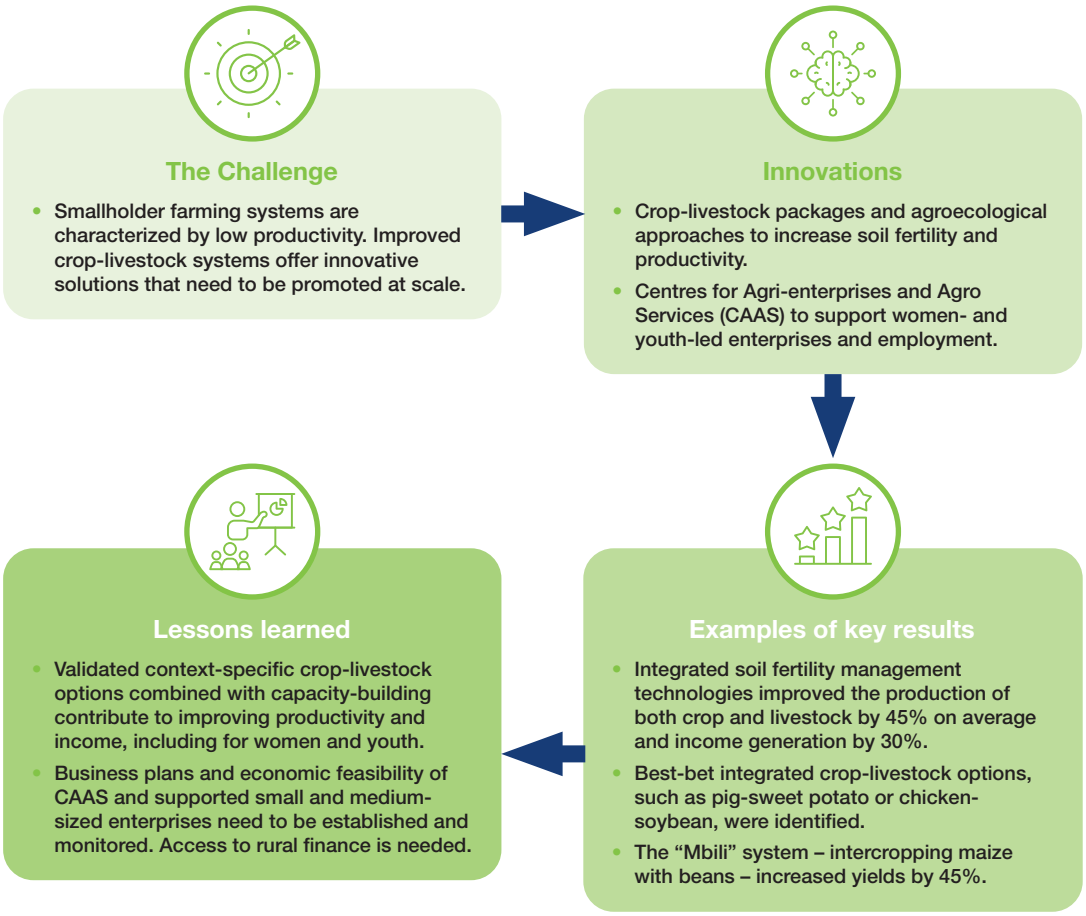
Overview

Smallholder production systems are characterized by low productivity. Promotion and improvement of crop-livestock systems can considerably improve productivity and contribute to the achievement of several SDGs. This project's goal was to enable poor rural people to improve their food security and nutrition, raise their incomes and strengthen their resilience through sustainable intensification of crop-livestock systems linked to markets, with a particular focus on gender and youth.



The innovations

The project promoted several production techniques, practices and approaches that contributed to enhancing the outcomes of crop-livestock packages for the target populations. These innovations included: introduction of inoculated soya for fodder production, which also improved soil fertility, as well as intercropping or rotating maize-bean associations and use of composted organic manure (livestock by-products); and agroecological approaches centred on a crop-livestock system: rabbit or pig farming systems associated with forage and/or vegetable production systems focusing on-farm production of livestock feed, adding value to by-products (e.g. urine from rabbit farming sold as fertiliser [urea]). Centres for agri-enterprises and agro services (CAAS) were also established and supported for women and youth employment and capacity-building.

Benefits to rural communities

- The integrated soil fertility management (ISFM) technologies promoted improved the production of both crop and livestock by 45 per cent on average and income generation by 30 per cent.
- Intercropping with animal feed growing (maize with beans, soybeans and lablab) and evaluation of best-bet ISFM in the Democratic Republic of the Congo increased yield and income. For example, the total income per hectare has risen to US$1,700, compared with US$1,200 for farmer practices. Yields of legume fodder considerably increased (between 1.5 t/ha and 3.5 t/ha) when in association with maize in the Kamanyola project site.
- The “Mbili” system, which consists of intercropping yellow maize with iron- and zinc-rich beans or yellow maize with beans/soybeans, showed better yields than traditional farmer practices. Yields increased by 45 per cent on average.
- The best-bet integrated crop and livestock options identified in the Democratic Republic of the Congo are: cattle-maize, rabbit-sweet potato, goat-beans, pig-legumes or sweet potato, goat-maize, chicken-soybean and cattle-rice.
- The livestock solidarity chain allowed for addressing constraints of limited stock by passing improved livestock breeds on to new beneficiaries.
- Integration of livestock (rabbit) into cropping has improved the income from sales of rabbit breeding stocks, increased manure application (rabbit droppings) by farmers, and reduced input costs to vegetable production in five subregions of Giheta (Burundi).
- The nutritional status of women and children was improved through the introduction of biofortified varieties of maize, cassava, beans, green vegetables and mushrooms. The adoption of yellow-fleshed sweet potato, introduced to make more vitamin A available, also resulted in more vines for animal feed.
- CAAS supported the development of women- and youth-led agro-enterprises, including in pig and poultry farming, maize and cassava processing, veterinary offices, improved access to quality seed and breeds, and good agronomic and managerial practices. The cassava flour, maize and soybean produced by youth agripreneurs are of better quality and preferred by consumers than their traditionally produced equivalents.

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Lessons learned

Different crop-livestock integration options exist and can be assessed and promoted for different contexts. Innovative approaches can result in increased productivity and income and contribute to effectively addressing smallholders' needs and constraints, and present effective opportunities for empowering women and youth.

Development of business plans and monitoring of economic sustainability and profitability of CAAS and agro-enterprises are needed to ensure that they are self-sustaining and profitable or to identify any adjustments required.

Scaling up and sustainability

The multiple benefits of integrated crop-livestock systems options that are adapted to specific contexts are the foundation for interest by smallholders, and therefore adoption at scale.

Engagement of relevant stakeholders at different levels, including the individual smallholders, farmer organizations, NARES (including veterinary services), VC actors including processors and traders, and policymakers (ministries of agriculture and livestock) are also required to ensure scale-up and sustainability.

RESOURCES

ILRI. 2019. *Final report of the project 'Improved productivity through crop-livestock interventions in Eastern DR Congo and Burundi (CLiP)'*. https://core.ac.uk/reader/132676400

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CATEGORY 2

G | Innovations for improving aquaculture and agricultural systems production for nutrition – WorldFish

PROJECT TITLE

Managing aquatic agricultural systems to improve nutrition and livelihoods in selected Asian and African countries

COUNTRIES

Cambodia, Indonesia, Thailand, Zambia (2016-2020)

IMPLEMENTING INSTITUTION

WorldFish

Overview

Development partners have shown increased interest in nutrition-sensitive agriculture, which includes the potential role of fish for supplying essential fats and micronutrients for brain development and cognition in young children in the first 1,000 days of life. Improving small-fish farming systems can contribute to this objective and to other development outcomes. The goal of the project was to improve the nutrition and livelihoods of poor rural HHs in aquatic agricultural systems through increased intake of micronutrient-rich small fish and vegetables from their own production, as well as through increased HH income. Its objective was to scale up in selected communities in the target countries the integrated aquaculture and fisheries-agriculture-nutrition linkages approach. Developed and practised in Bangladesh, this approach improved the production and productivity of HH ponds and dykes, increasing total and small fish production and fish species diversity in wetlands and supporting initiatives to increase consumption of micronutrient-rich small fish and vegetables.

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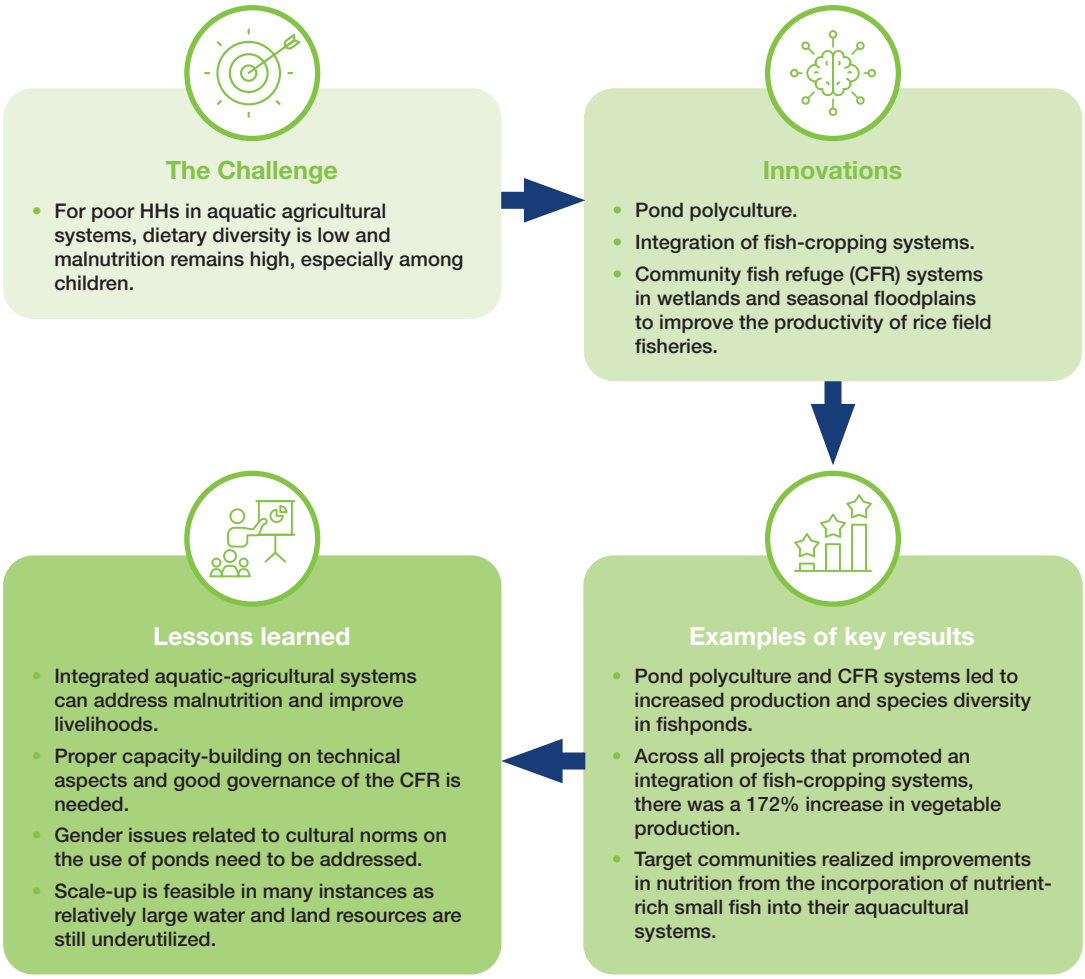

The innovations

The integrated innovative approaches and technical innovations promoted involved the use of **small fish as an entry point to address issues of malnutrition while improving livelihoods by engaging rural HHs in aquatic-agricultural systems through promotion of pond polyculture and integration of fish-cropping systems.** Small fish are incorporated in aquaculture, targeting commercial and small HH fishponds and capture fisheries through **the management of a community fish refuge (CFR) system in wetlands and seasonal flood plains (figure 5).** The CFR system is a village/community-protected pond established in seasonally inundated rice fields located far from natural permanent water bodies. The ponds are connected to rice fields through canals or fish pathways so that fish can reproduce and grow out naturally in the flooded rice fields during the rainy season. Additionally, a CFR is a form of fish conservation measure that stabilizes fish populations in rice fields and provides safe refuges for fish during the dry season, and thereby improves the productivity of rice field fisheries. **Small fish have higher nutritive value than large fish because they are consumed whole.**

Figure 5: Community fish refuge

1

IDENTIFY

A viable rice-field fishery is identified where a community is already fishing from a natural or artificial pond/pool during the rainy season

2

IMPROVE

Physical improvements are made to the community fish refuge (CFR) to improve water retention and flow

3

EXPAND

The ponds are connected to rice fields through canals so that fish can reproduce and grow out naturally in the flooded rice fields

4

ELECT

Local volunteers are elected to democratically govern the communally managed refuge

IMPROVED NUTRITION

Small fish from the ponds are ground and incorporated into children's food to improve nutrition at the HH level

IMPROVED INCOMES

Surplus fish available from enhanced productivity is sold at markets to increase HH income

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Benefits to rural communities

In Cambodia, **target communities benefited from nutrition-sensitive approaches that promote vegetable production on the banks of the CFRs and ponds in rice fields** in the dry season, homestead pond polyculture with large and small fish, homestead vegetable gardening, fish processing through the drying and preparation of fish powder from small fish for young children's diets, nutrition messaging, promotion of consumption of small fish, with a focus on the first 1,000 days of life, pregnant and lactating women and young children, and hygiene through handwashing and clean preparation of foods.

The project increased yields and species diversity in fishponds. Nutrient-rich small fish were added to homestead ponds at an increased density of 1 kg/100 m^2 of pond area. Homestead ponds in Cambodia produced an average of 78.5 kg of fish, of which 4.4 kg was micronutrient-rich small fish, whereas rice field ponds produced an average of 87 kg of fish, of which 3.5 kg was small fish. The average vegetable production per household was 73.5 kg/year. Six months of monitoring by the 143 households involved showed a 172 per cent increase in vegetable production – from 323 kg to 528 kg.

In Zambia, the project **increased availability, access to and consumption of micronutrient-rich small fish from HH ponds.** Twenty ponds were stocked with four or five different fish species. The final sampling at end-line showed that almost 119 kg of small fish were harvested, of which about 81 kg were consumed and about 38 kg sold. Some 54 kg of the 59 kg consumed by women was during the fish ban (1 December 2019 to 1 March 2020), when availability and consumption of fish from vendors and the wild were greatly reduced. The small fish are either consumed fresh locally or processed at household level into fish powder, which is added to food for children, as in Cambodia.

Lessons learned

Improving women's and children's nutrition and smallholders' livelihoods by engaging rural HHs in aquatic-agricultural systems through the promotion of pond polyculture and integration of fish-cropping systems constitute effective innovative approaches that respond to multiple development and NRM issues. Engagement of the communities in the management of the aquaculture and cropping systems is required where these innovations can be applied at scale.

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Gender issues related to cultural norms in relation to the ponds need to be considered and addressed according to the contexts .

Capacity-building of the target smallholders to be involved is needed. The pond polyculture pilots can be faced with high fish mortality rate during transfer, ownership and management of the ponds by the HHs. Such issues can be solved with proper acclimatization techniques.

Scaling up and sustainability

According to WorldFish, with adequate government engagement and investment support, aquaculture is poised to grow exponentially in the region for the following reasons.

- Resources – while the project's innovations are not applicable everywhere, there are relatively large water and land resources that are still underutilized for which they can be assessed and scaled, particularly when they offer opportunities to contribute to achieving national and regional strategies on aquaculture and agricultural systems.
- Conducive socio-economic factors – low cost of labour and existing large employable population; growing demand for fish and fish products; and increased awareness of the public health and socio-economic benefits of fish.
- Policy and legislative frameworks – governments' recognition of aquaculture as an economic subsector for economic diversification, job creation, poverty reduction and intra-trade facilitation through free trade areas such as the Common Market for Eastern and Southern Africa (COMESA).

The support provided for the formulation of the following policies by the Department of Fisheries, Zambia and the Civil Society Scaling Up Nutrition Alliance will also foster sustainable upscaling of the innovations: (i) the policy on **"Contribution of Small Indigenous Fish Species in the 1,000 Most Critical Days of Life in Zambia"** with recommendations including the need to increase the frequency and quantity of small indigenous fish species (SIS) consumed by women and children

in rural Zambia; school programmes to include education and knowledge-sharing about the nutritional value of SIS and how to introduce them into the Zambian diet; and the investments needed from the Ministry of Fisheries and Livestock, Ministry of Education, Ministry of Lands and Natural, Resources and other relevant bodies in education and research, on how to improve production and consumption of SIS; and (ii) the policy on **"The Role of Pond Polyculture to HH Fish Consumption in Zambia"**, with recommendations on the need to support related research and consideration of gender dynamics in this sector.

RESOURCES

African Union. 2016. The Continental Aquaculture Development Action Plan 2016 – 2025. Stakeholders' perspectives for implementing the Policy Framework and Reform Strategy for Fisheries and Aquaculture in Africa. https://www.globalseaweed.org/wp-content/uploads/2019/02/AU_IBAR_2016_10year_plan.pdf

WorldFish. 2020. Final report of the project 'Managing aquatic agricultural systems to improve nutrition and livelihoods in selected Asian and African countries: Scaling learning from an IFAD-WorldFish collaboration in Bangladesh'.

IFAD. 2021. Consolidated report of the PRUNSAR programme.

WorldFish. *One pond at-a-time: Pond polyculture now possible in Northern Zambia.* https://worldfishcenter.org/blog/one-pond-time-pond-polyculture-now-possible-northern-zambia

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CATEGORY 2

H | Innovative holistic value chain approach for promoting NUS to improve nutrition and climate adaptation – Bioversity International

PROJECT TITLE

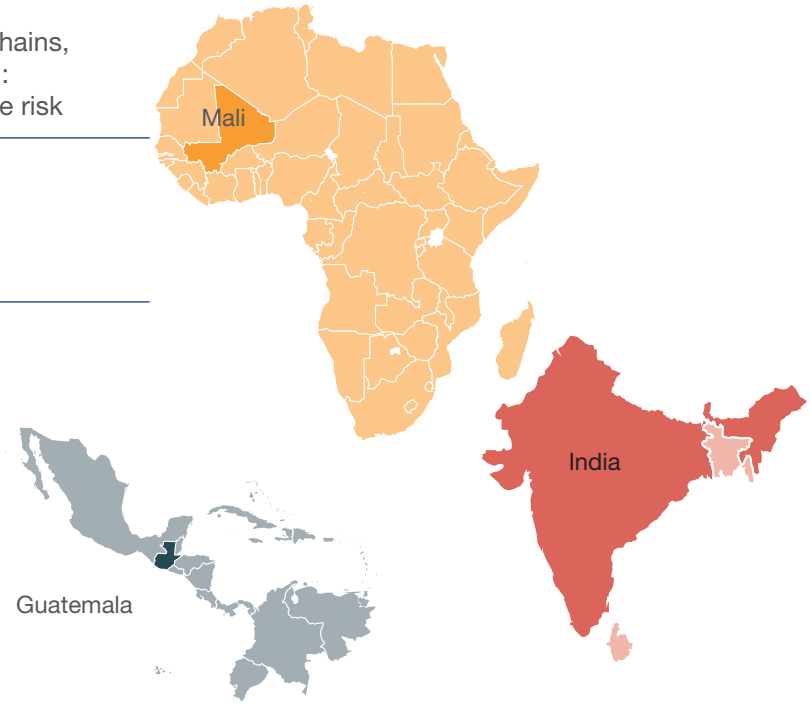
Linking agrobiodiversity value chains, climate adaptation and nutrition: empowering the poor to manage risk

COUNTRIES

Guatemala, India, Mali (2015-2020)

IMPLEMENTING INSTITUTION

Bioversity International



Overview

Climate-resilient neglected and underutilized species (NUS) offer solutions to improve poor smallholders' and their communities' nutrition, income and adaptation to climate challenges. The goal of the project was to contribute to achieving food and nutrition security and economic empowerment in local communities facing climate risks. Specific objectives included strengthening the capacities of vulnerable women and men, farmers, VC actors and NARS to cope with climate change through participatory research focusing on underutilized stress-tolerant varieties and associated management practices for improved climate adaptation, nutrition and marketing opportunities (by strengthening the capacities of indigenous and local women and men farmers and development practitioners to assess, document, monitor, conserve and manage stress-tolerant varieties of traditional crops for their effective deployment in VC and resilient livelihood strategies); strengthening community-based organizations and mechanisms and processes managed by local communities (including indigenous people) to share with peers and partners (including researchers) best practices for the sustainable conservation and use of agrobiodiversity; and strengthening the capacities of NARS to deal with climate risks within a holistic VC approach and promote scale-up of successful approaches through collaborative linkages with local communities, and major national and international agendas.

The Challenge

- Many climate-resilient species that have great potential to improve smallholders' nutrition, income and adaptation to climate change are neglected and underutilized.

Innovations

- Holistic VC and community-based approaches, including community seed banks, networks of farmers using community biodiversity management, biodiversity field fora and seed fairs.
- Innovative partnerships to strengthen market access, including with the gastronomy sector and educational institutions (school meals).

Examples of key results

- Resilient and nutritious NUS were identified and disseminated with better agronomic practices.
- Consumption and sales of NUS were increased through linkages with VC actors in markets, stores, restaurants, schools.
- Projects increased employment for women and improved nutrition through NUS VC development.

Lessons learned

- Awareness-raising, capacity-building in financial and business skills, access to inclusive rural finance products are essential for promoting NUS.
- Establishment and strengthening of farmers' networks, access to information on climate change and the role of agrobiodiversity in climate change adaptation are key.
- Policy recommendations on NUS need to be developed for governments, development practitioners and the private sector.

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The innovations

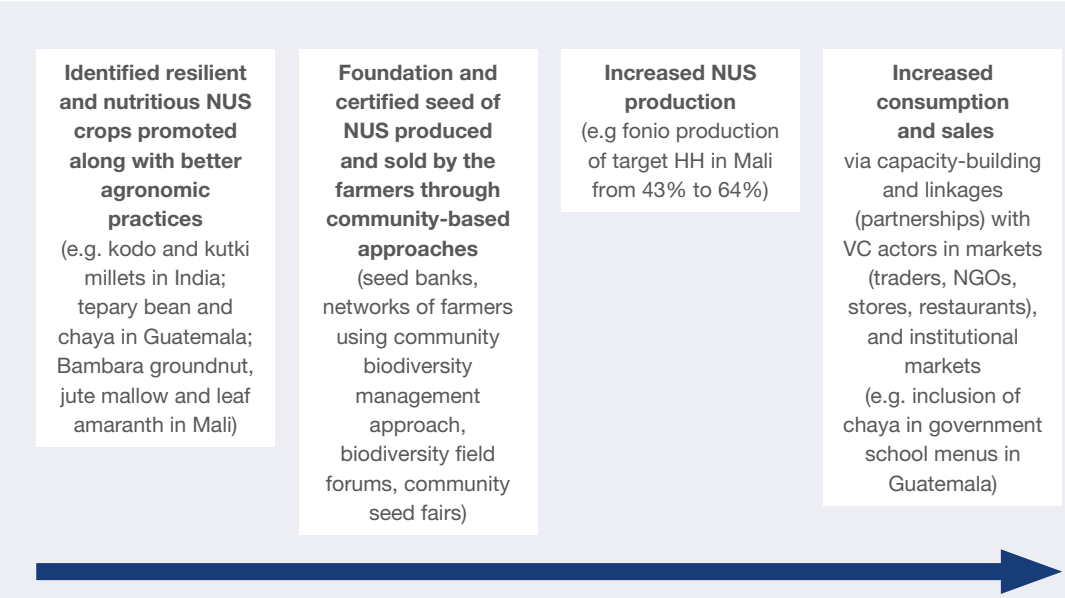
The integrated approaches used and promoted by this project included the following.

A holistic VC approach (figure 6) combined with novel community-based approaches and models and used to address nutrition gaps and improve resilience and adaptation to climate change. The NUS included kodo millet and kutki millet in India; tepary bean and chaya in Guatemala; and Bambara groundnut, jute mallow and leaf amaranth in Mali.

The innovation network approaches used included: in Guatemala, the **national network of community seed banks; in Mali, community seed banks and networks of farmers using community biodiversity management approach** for the monitoring of local agrobiodiversity through community biodiversity registers; and in India, **biodiversity management** committees, which are responsible for documenting data on local biodiversity in biodiversity registers following the guidelines of the Madhya Pradesh State Biodiversity Board.

Holistic VC development approaches used included: in Mali, **biodiversity field fora, community seed banks and seed fairs** for stimulating re-uptake and adoption; in India, **a business model for millet promotion through farmer producer companies**, which benefited producers with higher farm gate prices and profit-sharing among shareholders, who are predominantly local women; and in Guatemala, **partnerships with the gastronomy sector for raising the profile of NUS while reinforcing local culinary identities and creating employment opportunities for women, and inclusion of chaya into the menu of the government schools** in Chiquimula Department has contributed to adoption of nutritious NUS among youth.

Figure 6: Innovative holistic value chain approach for promoting NUS to improving nutrition and climate adaptation



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Benefits to rural communities

Almost 6,500 farmers and about 250 experts from NARS involved in this project directly benefited from the development of seed systems of the target crops, strengthened market access for stress-tolerant and nutritious crops, sustainable conservation and use of agrobiodiversity, climate change information for agricultural production management, training of NARS staff in holistic VC development, development and use of agrobiodiversity monitoring tools, policy recommendations on the promotion of use of local diversity at national and international levels, and collaboration with ASAP and CCAFS.

Eight resilient and nutritious crops were identified and disseminated along with better agronomic practices[17]: kodo millet and kutki millet in India; tepary bean and chaya in Guatemala; and Bambara groundnut, fonio, jute mallow and leaf amaranth in Mali. More than 100 tonnes of high-quality seeds produced by trained farmers were shared or sold, creating new sources of sustainable income; yield and adoption of focus crops increased in target areas; and seasonal calendars were developed and disseminated to assist communities in making better use of local food diversity.

Markets and VCs of focus crops were mapped and improved through more efficient cultivation, harvesting, processing and marketing, collaborative platforms and awareness campaigns; farmers cooperatives with thousands of members have been established, VC actors trained; NUS-based nutritious and novel food items were developed, attractive recipes promoted by restaurants, and media and school meal programmes have contributed to diversify diets and reinforce nutrition.

Physical and human capacities of farmers, VC actors and experts from NARS have been reinforced and/or built to identify, conserve, document, grow, process, sell and consume stress-tolerant NUS and their products; **community seed banks and seed farmers' networks** created to maintain diversity and knowledge of target crops in situ/on farm; cooperatives created to better link farmers to markets raised incomes of local farmers; processing equipment provided to communities has eliminated drudgery, making value addition more efficient and remunerative and greatly benefiting women; higher levels of self-consumption and sales of NUS have been recorded

17 These crops stood out in multi-stakeholder consultations at the onset of the Project as best options in view of their high nutritional profiles, high appreciation in local food cultures, and capacity to produce under to the effects of climate change such as soil degradation and unpredictable rains.

through the endlines, thanks also to numerous fairs and exhibitions organized to celebrate local food cultures and healthy diets intimately linked to NUS.

Varietal trials assessed performance of varieties of kodo and kutki millets in India, tepary bean in Guatemala, and Bambara groundnut and fonio in Mali.

High-quality seed of stress-tolerant varieties managed and produced by women and men farmers: In **India**, 97,188 kg of foundation and certified seed of kodo and kutki millets was produced and sold by the farmer producer companies established through the Project. In **Guatemala**, 18,700 chaya cuttings were distributed for home gardens and community nurseries. In **Mali**, about 8,350 kg of fonio seed and 11,544 kg of Bambara groundnut were produced.

Farmer-led intelligence systems to support local producers: In **India**, the Project nurtured the development of four farmer producer companies for marketing millet. In Guatemala, the collective marketing cooperative "Integral Marketing Cooperative Chorti", was established with 300 members, mostly women.

A system of delivering weather information to farmers by SMS: 1,000 farmers were connected with an SMS weather information service provided by the Indian Farmers Fertiliser Cooperative Limited.

Increase in production and the yield:

Production and yield increases					
Country	Crop/variety	Adoption by households (%)		Yield (kg/plant per year)	
		2015	2018	2015	2018
India	Kodo millet	52	66		
	Kulti millet	57	67		
Guatemala	Chaya	30.7	97.1	1.71	2.87
	Chaya cv. 'Estrella'	18	33		
Mali	Fonio	43.3	63.7		
	Bambara groundnut	49.7	87.2		

On increase in demand and market access: Four products with chaya were sold in **18 stores** in Guatemala. No restaurant offered dishes with chaya in Guatemala City in 2015, while in 2019 **two restaurants** ranked among the best introduced chaya. Furthermore, chaya was approved as an ingredient in school meals for Chiquimula Department in 2019.

Demand and market access increase					
Country	Crop/variety	Marketing (% HH selling)		Consumption (% HH)	
		2015	2018	2015	2018
India	Kodo millet	10	35.0		
	Kulti millet	16	30.4		
Guatemala	Chaya	0	11.4		
Mali	Fonio	14.0	20.0	47	100
	Bambara groundnut	19.4	100	54	99.4

Lessons learned

Development of inclusive rural finance products and capacity-building in financial skills (with an emphasis on savings which lead to financial self-sufficiency, and lower donor money dependency) need to be integrated in projects that promote NUS for poor smallholders to provide the necessary financial basis for adoption, value addition and access to competitive urban markets, and therefore sustainable scale up.

Scaling up and sustainability

Scaling up and sustainability were achieved through establishment and strengthening of farmers' networks and providing farmers with access to information on climate change for better management of their agricultural production. For example, in **Mali**, radio broadcasts to raise awareness on climate change and the role of agrobiodiversity in adaptation were made in French and four local languages with a total audience about 1,431,200 people.

Policy recommendations were also developed for national governments and international agencies, including: (i) improving access to diversity and high-quality seed; (ii) support conservation of NUS diversity; (iii) support and encourage production and demand for NUS; (iv) improve VC organization and market information systems for NUS; (v) develop and disseminate improved processing technologies; (vi) raise awareness and demand among consumers; (vii) foster collaboration across actors; (viii) develop research capacities for NUS; (ix) include NUS in policies addressing global challenges at local, regional, national and international levels; and (x) foster the role of NUS development for the benefit of women, youth and indigenous peoples.

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CATEGORY 2

I | Integrated innovative solutions to improve NRM and livelihoods with bamboo – INBAR

PROJECT TITLE

South-South knowledge transfer strategies for scaling up pro-poor bamboo livelihoods, income generation and employment creation, and environmental management in Africa

COUNTRIES

Ethiopia, Madagascar, United Republic of Tanzania (2014-2018)

IMPLEMENTING INSTITUTION

INBAR
INTERNATIONAL BAMBOO AND RATTAN ORGANIZATION

Overview

The goal of this project (with India as the South-South technical partner) was to mainstream technologies and innovations based on bamboo for improved food, nutrition, energy and environmental security for reduced rural household poverty and improved natural resources management. The main objective was to scale up the benefits of bamboo, namely: reversing deforestation; reducing soil erosion; protecting riverbanks; substituting fodder and feed in farming systems; increasing power availability to poor rural households (in the shape of fuelwood and charcoal); and developing inclusive enterprise models for energy products and bamboo products. The project has four specific objectives: (i) promote bamboo for environmental management to reverse deforestation, reduce soil erosion and protect riverbanks through large-scale planting actions; (ii) integrate bamboo in farming systems to increase the resilience of poor rural households without competing for land used for food crops; (iii) develop inclusive NGO-community-private partnership (NCPP) enterprise models for organized household charcoal and small-scale farmer waste biomass aggregation; (iv) develop inclusive enterprise models producing bamboo commodities and products for diverse markets.

© INBAR

The innovations

Integrated technical innovations and innovative approaches included the following.

South-South partnerships: The project focused on innovative approaches, transferring field-validated technologies and knowledge between the participating countries (Ethiopia, Madagascar and Tanzania) and India (South-South provider), thus benefiting IFAD target groups, especially farmers, women and young people.

Household-centred approach: The programme adopted a HH-centred approach in planting bamboo on homesteads, along farm boundaries, on the banks of rivers and streams, and as shelter belts, thus creating a micro forest. Micro nurseries are another HH-centred approach that enabled communities to establish micro nurseries in HHs and on farms. The nurseries generated sales and income as farmers worked to meet high demand for planting materials. Micro and HH tissue culture units: the project developed and validated micro and HH tissue culture labs that

helped produce large numbers of plants quickly and affordably. Apart from bamboo, the labs could subsequently provide other plants needed by farmers.

Food security from bamboo: Farmers were trained in sustainable bamboo management for different uses such as bamboo poles, bamboo shoots and fodder. They were also shown how to harvest and process bamboo leaves and use them to feed animals – an added benefit providing not only savings for farmers and women, but also increasing cow milk production.

NCPP enterprise approach: The NCPP model proved a viable way of promoting community-led enterprises.

Bamboo for powering rural households: A 25 kWh gasifier was installed to produce electricity from bamboo biomass and farm waste in Tongarivo, Madagascar. It was designed to improve the quality of life of local residents and lead the way for the development of agro-industries and off-farm enterprises, thus creating new opportunities for poor rural people.

Allometric and environmental research: Important research on quantifying the potential of bamboo for soil erosion control, water recharge and improved soil quality was conducted through pilot plots established in each of the three project countries. Linking community-led bamboo enterprises to homesteads and farms planting bamboo boundaries contributed to land restoration.

Bambusetum, or bamboo demonstration garden: a bambusetum, with a variety of native and exotic species, was created to help researchers, policymakers and interested parties to learn about bamboo.

Benefits to rural communities

Environmental management: About 555,700 bamboos of 12 species were produced at the nursery level and were then planted on 357.86 hectares of degraded land.

Bamboo farming system development: 3,384 targeted HHs set up micro nurseries at HH level. Some 391,500 bamboo plants were produced at individual HH level. Twenty-two farmer field schools and farmer training centres were established to familiarize participants with micro planting. Nearly 2,690 HHs benefited from training in the use of bamboo as feed, food and biomass. Research on bamboo feed in Madagascar showed that the plants with the highest protein content were *Bambusa bambos* (15.43 per cent protein), followed by *Bambusa tulda* (14.95 per cent) and *Dendrocalamus giganteus* (14.29 per cent). Used as fodder for cattle, the plants can help increase milk production by 10-12 per cent.

Photos: Bamboo vegetative propagation, macro-proliferation and nursery management (Source: INBAR project final report)

NCPP model enterprise for household charcoal: 5,072 women were mobilized and trained on quality, bamboo-based charcoal production for clean household energy. Inclusive social enterprises based on the NCPP model were set up with local partners in three project areas.

Diversified livelihoods: Seven common processing and training centres were established in the beneficiary countries, where they linked with 49 model enterprises. Training was provided to 1,363 young people on creating diversified bamboo microenterprises.

Lessons learned

During implementation, the project faced several challenges that needed to be addressed, and which constitute lessons for future interventions or investments. These included: land tenure and ownership rights were very unclear, national bamboo policies and strategies were often non-existent, and critical ecosystem restoration required dialogue with line ministries; bamboo development professionals and organizations were lacking; there was little co-funding for large-scale bamboo plantations and private-sector initiatives; and the development of quality planting materials of bamboo needed time and adequate investment.

Scaling up and sustainability

Bamboo offers a number of innovative opportunities that simultaneously address several development and environmental issues faced by smallholders, which make them interesting for adoption at scale for beneficiaries, and for development practitioners, governments and funding institutions.

Policy development for creating an enabling environment is also key to ensure sustainable scale-up. The project has supported incorporation of bamboo in country-level forestry action plans and policy development, which constitute important aspects of scale-up strategy. This includes the **Bamboo Policy and Strategy 2018** in Madagascar; the Tanzania Bamboo Strategy Development; and the **Ethiopia Bamboo Strategy Development**.

RESOURCES

IFAD. 2019. *Fighting poverty with bamboo*. Project brief. https://www.ifad.org/documents/38714170/41219860/poverty_bamboo.pdf/3dcd50ba-43e5-80aa-21bc-b446487ac599

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CATEGORY 3


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Innovations for more productive and healthier plants and animals through research, enhancement of human and social capital, and policy engagement to prevent and control diseases and a holistic one health[18] approach

J | Aquaculture technological foundations innovations to improve productivity – WorldFish

PROJECT TITLE

Improving the technological foundations for sustainable aquaculture

COUNTRIES

Bangladesh, Egypt, Malaysia, Timor-Leste (2015-2017)

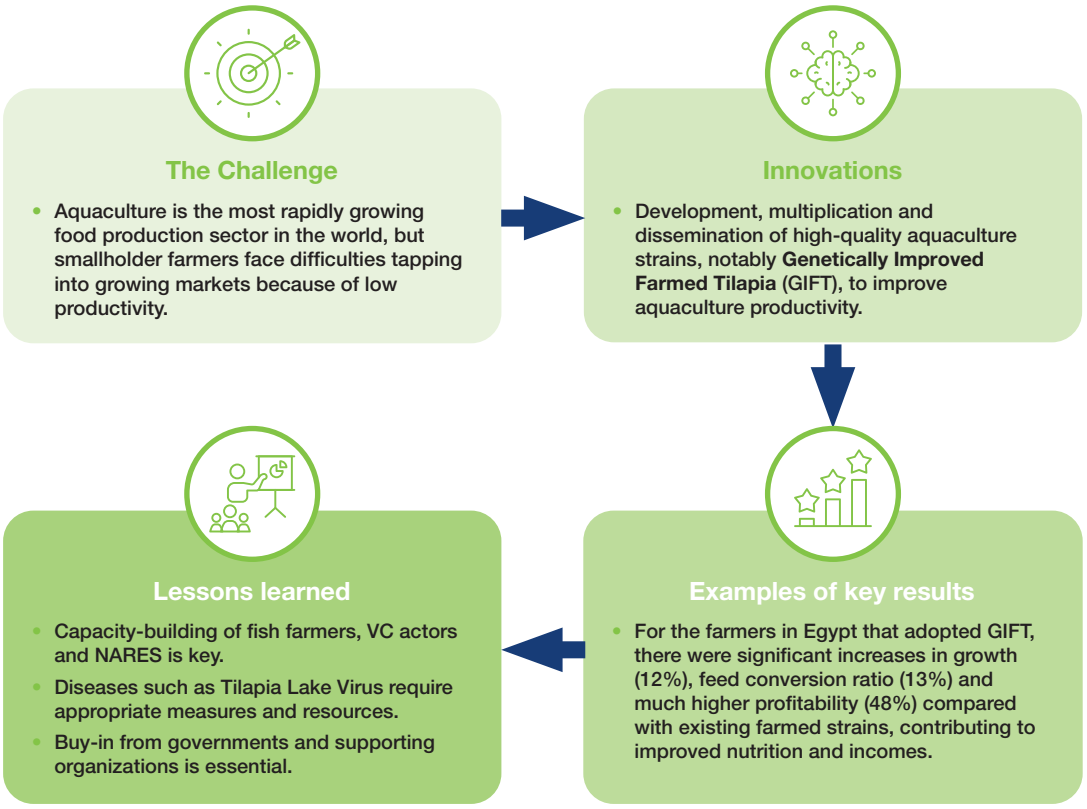
IMPLEMENTING INSTITUTION

WorldFish

18 'One Health is an integrated, unifying approach that aims to sustainably balance and optimize the health of people, animals and ecosystems'. (Source: https://www.who.int/health-topics/one-health#tab=tab_1).

Overview

Aquaculture represents an important potential resource for improving nutrition and income for fishers and their communities if its performance can be improved. The goal of this project was to develop, multiply and disseminate quality seed of key aquaculture species that increase productivity and profitability for farmers, while at the same time conserving the genetic resources of fish in anticipation of future needs. The objective is to improve fish strains and associated fish farming technologies through the production of genetically superior fish strains to increase fish production at minimum cost.



The innovations

The main technical innovation promoted in this project that can be adopted by smallholder producers is the **Genetic Improvement of Farmed Tilapia (GIFT) fish**. Other innovations developed by the project, which can be used by NARES, included the development of methods to rear Rohu carp in hapas, which improved the efficiency of breeding programmes, molecular markers to identify different improved tilpia strains and so allow improved measurement of adoption and farm performance, and methods to accurately measure feed efficiency in tilapia.

Benefits to rural communities

Surveys of on-farm performance of improved tilapia strains highlighted that the adoption of the GIFT strain could be identified at 73 per cent of the pond areas of the target regions of Bangladesh. The data from Egypt found significant increases in growth (12 per cent), feed conversion ratio (13 per cent) and much higher profitability (48 per cent) compared with existing farmed strains.

In Asia, red tilapia in Malaysia have also been developed and a new genetic improvement programme for carp has been establishedin Bangladesh .

Guidance on fish and prawn genetic improvement programmes previously developed with WorldFish has been disseminated, and advice provided to Ghana, India, Malawi and Viet Nam.

Lessons learned

Improved fish strains can considerably improve productivity, nutrition and income of fishers, their communities and the VC actors who can benefit from this improvement if properly it is disseminated with the capacity-building needed of different stakeholders involved at different levels.

Virus outbreaks such as Tilapia Lake Virus can cause difficulties and require the implementation of appropriate defensive infrastructures, which need more resources and specific operational procedures to ensure success.

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Scaling up and sustainability

Engagement and partnership with relevant national partners, such as the Rajiv Gandhi Centre for Aquaculture in India, are key to bolster the promotion and dissemination of GIFT and improved strains of fish in new target areas.

Capacity-building of target smallholders, as well as NARES and relevant VC actors, are required as well as engagement with and commitment of governments and supporting organizations to ensure successful scaling up and sustainability, particularly in the case of disease outbreaks.

RESOURCES

WordFish. 2017. *PRUNSAR project: Improving the technological foundations for sustainable aquaculture*. Technical report. https://worldfishcenter.org/publication/improving-technological-foundations-sustainable-aquaculture-technical-report-ifad

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CATEGORY 3

K | Innovations for improving livestock management through control of peste des petits ruminants – ILRI

PROJECT TITLE

Control of peste des petits ruminants (ECO-PPR) in Eastern and Western Africa

COUNTRIES

Burkina Faso, Ethiopia, Kenya, Mali, Rwanda, Senegal, Tanzania (2019-2023)

IMPLEMENTING INSTITUTION

ILRI

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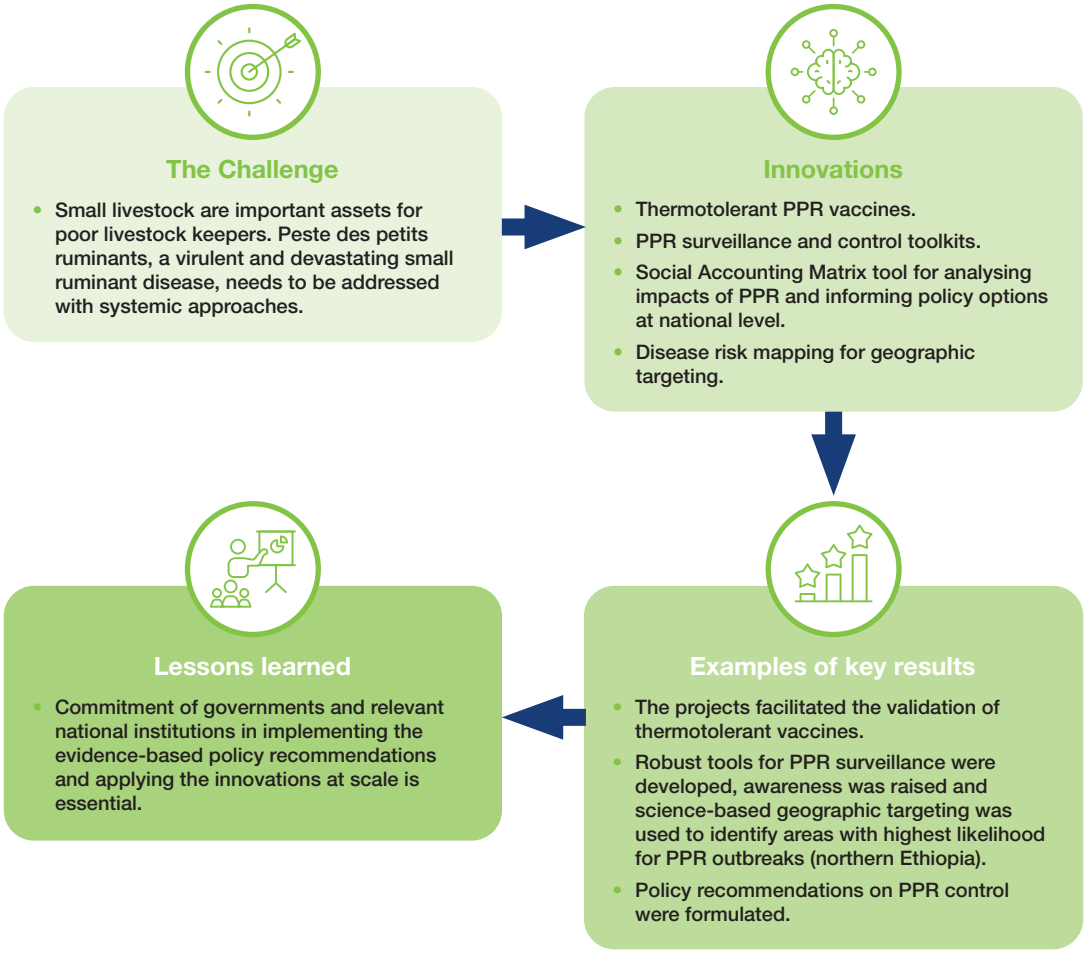
Overview

Small ruminants constitute crucial assets with multifunctional roles for livestock keepers in developing countries and their communities. They provide sources of income, livelihoods, readily available cash, animal-based protein, and they have socio-cultural functions. However, they are threatened by peste des petits ruminants (PPR), a disease that has high negative impacts. The control of PPR needs to be addressed with systematic approaches. The project "Efficient epidemiology and control of peste des petits ruminants (ECO-PPR)" targeted countries where pastoralism and agro-pastoralism are important sectors for rural development. The goal of ECO-PPR was to support ongoing global efforts in PPR control and eradication by generating the necessary evidence and tools to support policy dialogue to strengthen production of small ruminants in Eastern and Western Africa. The objectives of the project included: (i) veterinary services adopt national PPR control policies based on the understanding of disease epidemiology and transmission dynamics; (ii) veterinary services and farmers access well-validated vaccines and use vaccine delivery models appropriate for specific epidemiological and geographical situations; and (iii) veterinary services successfully implement PPR control programmes



The innovations

The innovative approaches and technical innovations generated and promoted included the following.

- Thermotolerant PPR vaccine adapted to local conditions.
- PPR surveillance and control toolkits: digitization of the PPR toolbox and the training materials developed for online learning, including the manual for the toolbox and the pre-recorded presentations for each tool, which can be streamed from a dedicated YouTube channel.
- Research methodology and results:
  - An analysis using a social accounting matrix, a useful tool for analysing policy options to inform discussions on the impact of PPR at national level by enabling (i) the evaluation of the role/importance of the small ruminant sector in the context of economic output, employment and household income; (ii) the estimation of how disease-mediated shocks, captured from past outbreak data on PPR, impact a range of different national economic sectors such as livestock and employment, while still capturing its short-term effects on the country's economy; and (iii) formulation of thorough evidence-based protocols and policy recommendations to preserve the livelihoods of HHs impacted by PPR.
  - Disease risk mapping: (i) northern Ethiopia has the biggest market node with largest radius (334 km) and highest likelihood ratio for PPR outbreaks; (ii) other significant clusters of PPR outbreaks were identified in Ethiopia.

Benefits to rural communities

Robust tools for PPR surveillance developed and used, and active surveillance of disease to detect and characterize PPR through capacity-building of the national, regional/county and local veterinary services personnel in the use of the tools and reporting, which includes skills in interviewing, data collection, data management, outbreak investigations, sample collection and point-of-care diagnosis.

Support to the national and regional veterinary services in Kenya and Tanzania to provide extension services during household visits, and as an incentive, the field team also dewormed sheep/goats that had not received any deworming treatments in the past three months using 10 per cent Albendazole.

Support to the regional laboratories in Ethiopia, Mali and Senegal in conducting laboratory assessments for the improvement of PPR surveillance in their countries.

Awareness raised and capacity of 7,946 small ruminant keepers in East and West Africa (half of them women) built on PPR.

Official validation of the thermostability profile for ILRI and Xerovax vaccines, evidence for investment decision options for a better allocation of resources in implementing PPR and other small ruminant disease control efforts in Burkina Faso and the Sahel, and training of field teams on key related topics (including data processing, PPR antigen rapid test kit for diagnosis of PPR, sample collection, handling and transportation, biosecurity, PPR disease surveillance, reporting and notification system, Participatory Disease Search, disease risk mapping and social network analysis, multi-criteria decision analysis and Spatial Qualitative Risk Analysis).

Evidence generated for policy engagement

- From pathogenicity studies: (i) more robust testing would be needed for early detection of the disease, to avoid disease transmission from asymptomatic animals; (ii) further investigation is also needed to verify the impacts of effective contact times on the transmission rates.
- Community-level dynamics that affect disease control: (i) vaccinating in September would allow for a better intervention before the onset of PPR outbreaks; (ii) climatic patterns influence movements and interactions that influence the dynamics of transmission of PPR, leading to outbreaks; (iii) animal movements related to festivals are not a predominant risk factor for PPR spread; (iv) an increase in the number of naive animals in the autumn (births in June and the flow of transhumant animals) could lower the immune status of animals and favour the resumption of transmission of the virus.
- Merits of vaccination strategies: all the vaccination scenarios for both 26.5 per cent (actual vaccination coverage) and 70 per cent (expected vaccination coverage) result in statistically significant differences in the gross margin earnings and the potential per capita consumption for the supply of mutton and goat meat thus justifying investment in PPR control.
- Disease risk mapping: northern Ethiopia has the biggest market node with largest radius (334 km) and highest likelihood ratio for PPR outbreaks, and other significant clusters of PPR outbreak were identified in Ethiopia, which is fundamental for identifying and prioritizing target geographic areas for prevention and mitigation interventions.

Lessons learned

Required success factors include a combination of technical and scientific innovations and capacity-building of smallholders and NARES by international research centres with engagement of policymakers, and commitment of governments and relevant national institutions in investing and applying the innovations at scale..

Scaling up and sustainability

The surveillance and control toolkits developed, the thermotolerant vaccines validated, capacity for manufacture supported and DIVA (differentiating infected from vaccinated animals) diagnostics development initiated by the project will be scaled for use in a pan-African programme for the control and eradication of PPR from 2024 to 2027.

RESOURCES

ILRI. 2019. Epidemiology and control of peste des petits ruminants in East and West Africa. ILRI Project Profile. Nairobi, Kenya: ILRI. https://www.ilri.org/research/projects/epidemiology-and-control-peste-des-petits-ruminants-east-and-west-africa

2nd PPR global research and expertise network (PPR-GREN) Meeting held in Nairobi, Kenya, 13-15 November 2019. https://rr-asia.woah.org/wp-content/uploads/2020/06/200622_ppr-gren-2-nairobi-november-2019-final-communique.pdf

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CATEGORY 4

Innovative partnerships and networks to improve APVC, NRM, CC and enhancing human and social capital and rural areas

L | Integrated innovative approaches for improving resilience with roots and tuber crops – CIP

PROJECT TITLE

Food resilience through root and tuber crops in upland and coastal communities of the Asia-Pacific (FoodSTART+)

COUNTRIES

India, Indonesia, Philippines and Viet Nam (2015-2019)

IMPLEMENTING INSTITUTION

CIP INTERNATIONAL POTATO CENTER

Overview

The resilience of agri-food systems to climate change requires innovative approaches, including in partnerships, to allow for swiftly and efficiently disseminating and adopting at scale climate-smart technologies and changes, including in cropping systems, such as by planting more resilient crops that can ensure food security and nutrition now and in the future. The goal of the FoodSTART+ project was to enhance food resilience among poor HHs in upland and coastal communities of the Asia-Pacific region by introducing root and tuber crops (RTCs) in IFAD-supported investment projects. Its three objectives were (i) identifying HH needs that are gender-sensitive by conducting vulnerability assessments among the food-insecure RTC-producing and RTC-consuming HHs; (ii) designing and implementing, with partners and local stakeholders, innovations that enhance food resilience; and (iii) developing effective partnership strategies with IFAD investment projects in promoting RTCs for food security at a larger scale.

The innovations

The novel integrated approaches for scaling up innovations in this project included the following.

Research approaches and results for guiding promotion of RTCs to contribute to addressing adaptation to climate change and resilience: Assessments of the role of RTCs to resilience and provide evidence for decision makers, and to identify RTC challenges and opportunities, including considering relevant natural resource and climate data, the RTC suitability and transformational maps, which provide projections on areas where RTCs are likely to replace other crops (e.g. maize) as a result of changing climate.[19]

Innovative approaches and partnership model for scaling up technical innovations: Farmer business school (FBS) approach, the grant-loan/investments partnership model for ensuring wider uptake, sustainability and scalability with Indonesia's Smallholder Livelihood Development project (SOLID, ended in 2018), Viet Nam's Sustainable Rural Development for the Poor in Quang Binh (SRDP, ended in 2018), Philippines' Fisheries Coastal Resources and Livelihoods (FishCORAL), Philippines' Integrated Natural Resources and Management project (INREMP), and India's Megha-LAMP, combined with the use of the innovative partnership health check-up tool to monitor the collaborations.

19 Palao, L.K.; Naziri, D.; Balanza, J.G. and Campilan, D.M. 2019. Transformational adaptation of key root and tuber crops in Asia: Species distribution modelling for assessing crop suitability in response to climate change. Final Report. Food Resilience Through Root and Tuber Crops in Upland and Coastal Communities of the Asia-Pacific (FOODSTART+) Project. Lima, Peru: International Potato Center. https://hdl.handle.net/10568/104048

Benefits to rural communities

Seven studies in six countries[20] assessed the role of RTCs for food security, livelihoods and nutrition in the target sites, and informed the collaborative work plans for high-potential sites, and better targeting of sustainable rural development, NRM and livelihood improvement.

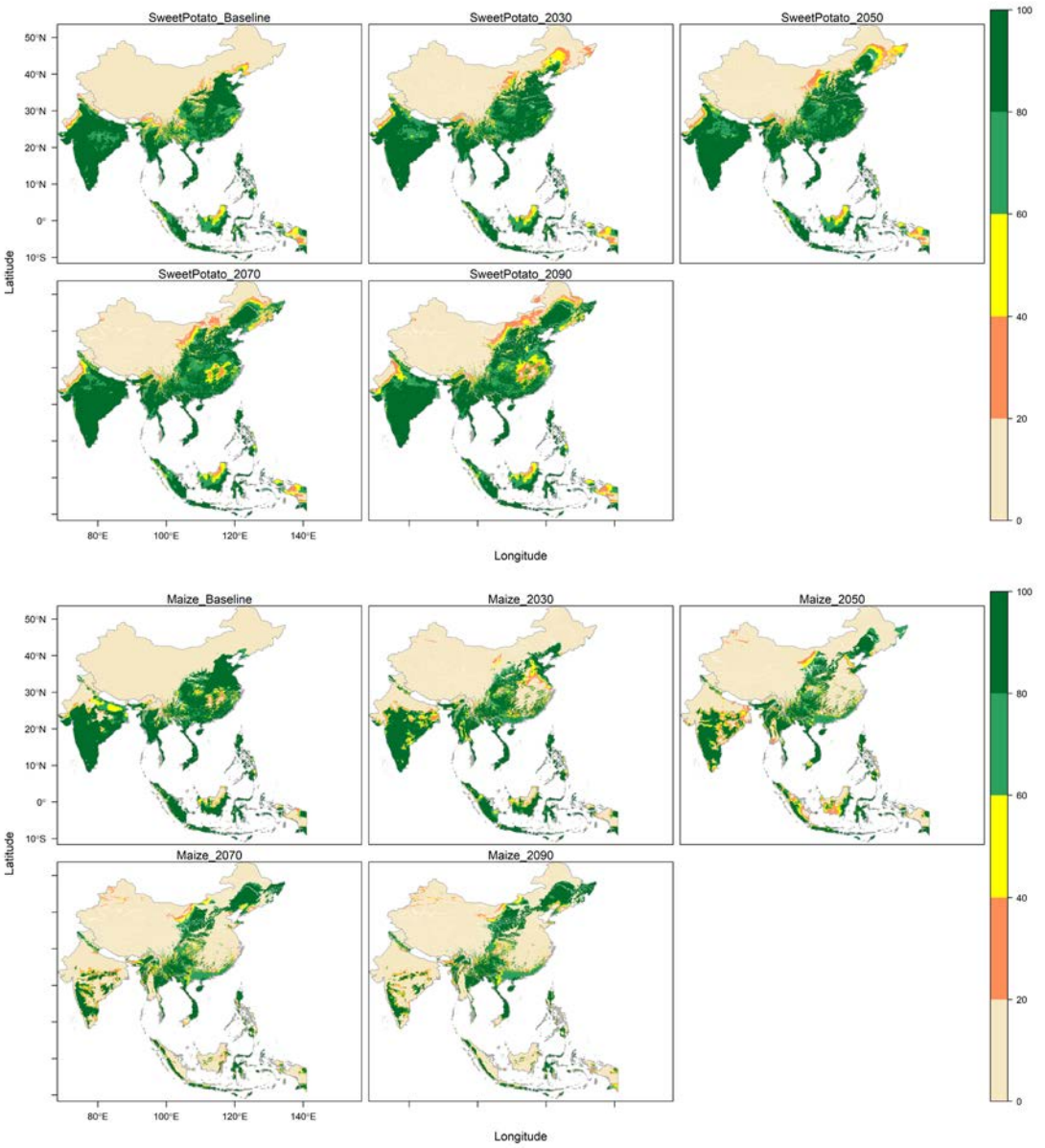
About 3,500 beneficiaries involved in **testing and promotion of new technologies to improve productivity and post-harvest management** through the FBS approach, in particular: introduction of nutrient-rich varieties of orange-fleshed sweet potato and yellow-fleshed cassava; introduction and multiplication of "dual-purpose" sweet potato seed for food and animal feed; and the processing of cassava for food and feed.

The RTC suitability maps developed based on land use and climate change scenarios on the future potential of RTCs and their likely increasing importance in the face of climate change identified areas in the Asia-Pacific region where considerable climate-related impacts that can threaten the agricultural viability of major crops are expected (the RTC suitability maps). The analysis included five RTCs (potato, sweet potato, cassava, yam and taro) and three key non-RTCs (rice, maize and banana). In areas where climate-related impacts are very high, it is assumed that the currently cultivated crops may need to be replaced by more resilient crops. The study confirmed that RTCs, particularly cassava and sweet potato being resilient crops, are likely to be substituted for other crops in the wake of climate change. **Figure 7** shows an example of the dramatic change in land suitability projected for maize, unlike sweet potato.[21]

20 India, Meghalaya State: Meghalaya Livelihoods and Access to Markets Project (Megha-LAMP) (Potato, sweet potato, cassava, taro); 2. Indonesia in Maluku and Maluku Utara provinces: Smallholder Livelihood Development Project (SOLID) (Cassava, sweet potato); 3. The Philippines: Fisheries, Coastal Resources and Livelihood Project (FISHCORAL) (Sweet potato, aroids) in Eastern Visayas Region; and Integrated Natural Resources and Environment Management Project (INREMP) (Sweet potato, cassava, yam) in the Bohol province; 4. Vietnam, Ha Tinh and Quang Binh provinces: Sustainable Rural Development Project (SRDP); 5. China, Hunan province: Hunan Agricultural Rural Infrastructure Improvement Project (HARIIP)(Potato, sweet potato): Myanmar, South Shan State (Potato); Ayeyarwaddy State (Cassava)

21 Source: Palao, L.K., Naziri, D., Balanza, J.G. and Campilan, D.M. 2019. Transformational adaptation of key root and tuber crops in Asia: Species distribution modelling for assessing crop suitability in response to climate change. International Potato Centre. https://cgspace.cgiar.org/handle/10568/104048

Figure 7: Land suitability for sweet potato (top) and maize (bottom) in Indonesia under 2030, 2050, 2070 and 2090 climate scenarios



Innovative research results that are ready for use generated by Megha-LAMP in India on organic management of potato tuber moth, the major potato storage pest in Meghalaya: The results showed that Lantana and Btk22 proved to be highly effective to control this potato storage pest.

With **SOLID in Indonesia**, new vitamin A-rich orange-fleshed sweet potato and yellow-fleshed cassava were introduced; cropping practices were disseminated through training of trainers; training on net-tunnel construction and management for clean sweet potato planting materials, including the development of the brochure 'High quality sweetpotato planting material production in net-house' in both English and the local language.

22 *Bacillus thuringiensis* subsp. *kurstaki* (Btk)

© IFAD/Susan Beccio

In addition, **different modes of partnership mechanisms[23] were also identified and discussed and a brief on good practices for scaling up innovations** was developed. Deeper analysis of the partnership arrangements is presented in a report.

The project also developed approaches on gender that can be promoted: (i) a gender checklist for introducing new RTC technologies to men and women and assess their gender responsiveness and (ii) production of gender-responsive participatory videos: a guide for facilitators.

Lessons learned

Innovative systemic, integrated and science-based approaches are needed to efficiently scale up technical innovations to adapt to climate change simultaneously in countries with similar contexts and challenges.

23 **Embedded:** Research project staff posted and based in the offices of the investment project in its operational area, to be the active promotor and facilitator of partnership interactions. **Neighborhood:** Research project staff based in an institutional setting with reasonable physical and collaborative access to investment projects, especially where more than one investment project is involved and/or where management of the investment project is split between local, provincial, and national levels. Involves locating the promotor and facilitator of the partnership in an institutional setting. **Provisional:** Research project staff based close to the national headquarters of investment project to facilitate interaction with its leadership. **Designated:** A government staff of the investment project's implementing agency designated as focal point for FoodSTART activities. Important for maintaining regular communications and decision-making interactions where appointment of an external, hired staff has provided difficult.

Scaling up and sustainability

The main FoodSTART+ scaling approach built on strong partnerships with IFAD investments, yet wider innovation dissemination and outreach require the involvement of other stakeholders (e.g. governments, international development agencies and the private sector) who can provide complementary services and market linkages. In the case of FBS, in addition to the agencies implementing the investment projects, technical support and business development service providers and financial institutions have become involved. Although the expert input and technical innovations initially provided by FoodSTART+ are critical to building capacities for implementation, strategic partnerships with these other stakeholders can provide largerscale benefits. In addition to strengthening the capacities of staff of the investment partners, the project produced a large number of knowledge products and organized events that facilitated engagement with policymakers and the private sector.

RESOURCES

International Potato Center. FoodSTART+ Asia. https://cipotato.org/cip_projects/foodstart-asia/

Palao, L.K., Naziri, D., Balanza, J.G. and Campilan, D.M. 2019. *Transformational adaptation of key root and tuber crops in Asia: Species distribution modelling for assessing crop suitability in response to climate change*. Final Report. Food Resilience Through Root and Tuber Crops in Upland and Coastal Communities of the Asia-Pacific (FOODSTART+) Project. Lima (Peru). International Potato Center. 34 p. https://cgspace.cgiar.org/handle/10568/104048

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CATEGORY 4

M | Improving flood-based systems management to enhance climate adaption – IWMI

PROJECT TITLE

Africa to Asia – Testing adaptation in flood-based resource management

COUNTRIES

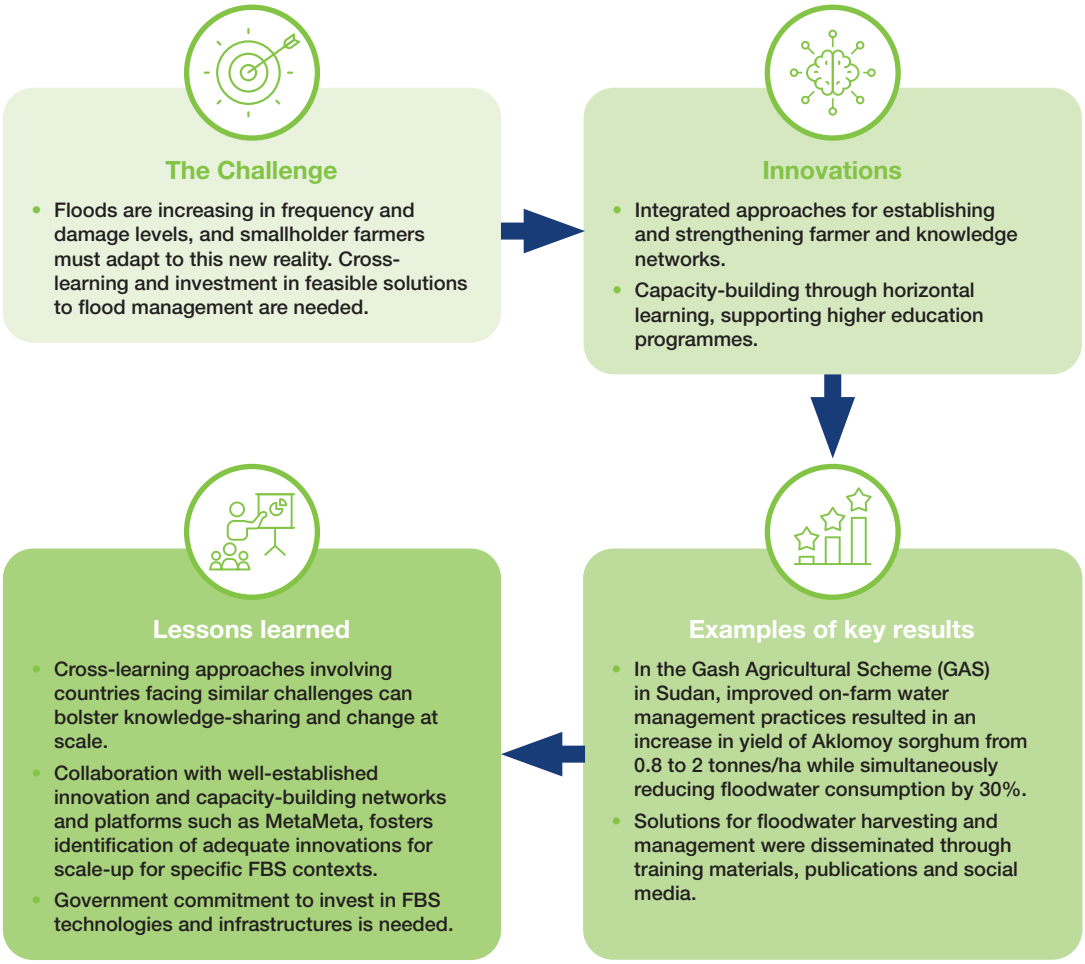
Ethiopia, Kenya, Malawi, Pakistan, Uganda and Yemen (2016-2020)

IMPLEMENTING INSTITUTION

IWMI
International Water Management Institute

Overview

Efficient and sustainable management of flood-based systems offer new opportunities to enhance smallholders' adaptation to climate change. The goal was to help to develop flood-based livelihood (FBL) policies and programmes that invest in rural people, draw from research and South-South documentation of experience, prioritize long-term capacity-building, and incorporate multi-level programme development. Its objective was to develop models and approaches on inclusive, gender-balanced growth in climate change-stressed areas that predominantly rely on FBL. Its specific objectives included the following. (i) A strengthened farmer and knowledge network established in Africa and Asia: building on the FBL Network Foundation, and on outreach of regional and national centres of ICRAF. The network is equipped with mechanisms for active engagement of farmer leaders and other practitioners (including policymakers, investors and educators) across selected countries in Africa and Asia. (ii) Human resources, local institutions and FBL knowledge strengthened: strengthened knowledge base of male and female staff from local institutions contributing to water and food security in areas where FBL is practised, taking evidence-based local practice in the eight target countries as the point of departure. (iii) Capacity-building on mainstreaming of FBL in farmer learning centres and in higher education, and contributing to the development of a group of young male and female professionals. (iv) Investment programmes and policies developed that are informed and shaped by good FBL practices, supported by South-South shared documentation and evidence-based research.



The innovations

Key innovations promoted by this project included capacity development through horizontal learning, which deals with the exchange of good practices, knowledge and ideas between groups of peers in which there is no monopoly on knowledge. It entails people coming together to see, observe, discuss and learn from people who have first-hand experience. Bringing groups together that have similar interests and challenges, such as farmers, can result in energy for mutual learning and create a self-evolving movement of new technologies and institutions. Farmers, practitioners and professionals were involved in various horizontal learning activities such as farmer exchange and knowledge-sharing events as well as training sessions where professionals and practitioners interacted with farmers.

Benefits to rural communities

AR4D activities **on improving water productivity in the Gash Agricultural Scheme (GAS) in Sudan** demonstrated how improved on-farm water management practices resulted in doubling of the yield of Aklomoy, a local sorghum variety used for food and fodder, from 0.8 to 2 tonnes/ha while simultaneously reducing floodwater consumption by 30 per cent. This has raised the interest of international partners; **Plan International has invested in replicating the field experiment on 800 ha cultivated by 600 farmers**, with the intention to further scale up should the results meet its standard for wider engagement.

Research in **Yemen** on the impact of war on food security in Tihama has drawn attention to the vulnerability of the spate irrigation-dependent areas in Yemen where attacks have made flood channels inoperable. Flood-based livelihood systems (FBLS) have been mainstreamed into the Irrigation Engineering course of the Faculty of Engineering of the University of Kassala, Sudan and the Water and Environment Centre of Sana'a University in Yemen.

Solutions for field water management, water distribution systems and the use of roads for floodwater harvesting have been developed and promoted through practical notes and other channels such as publications and local social media, as appropriate.

Capacity/skills development events for practitioners, professionals and policymakers. These include four training courses on Integrated Watershed Management and Flood Based Farming in Arid and Semi-Arid Lowlands of the Horn of Africa, leadership courses and a knowledge and experience sharing symposium. In addition, through its pioneering internship programme, partners have helped to develop capacity of young professionals in FBL research at BSc, MSc and PhD levels.

The farmer network in **Pakistan** is a good example of a network which has not only increased in membership but is proactive in coordinating its own initiatives, such as seed exchange. Also in Pakistan, funding has been secured from the Ministry of Economic Affairs of the Netherlands to introduce international good practice and better water distribution.

More than **4,000 farmers** enhanced their know-how on good floodwater management practices and techniques and other topics, by actively participating in knowledge-exchange events, targeted training and solutions-oriented research activities.

Promising results from two FBLS schemes in Ethiopia have shown ways to combine traditional and modern practices to improve irrigated area size and flood diversion efficiency for the benefit of more than 3,000 farmers.

Lessons learned

Innovative cross-learning approaches involving relevant stakeholders from countries facing similar challenges have potential to bolster knowledge-sharing and change.

Involvement of well-established innovation and capacity-building networks such as MetaMeta, consideration of adequate innovations for promotion specific contexts, and engagement and commitment of government in investing in capacity-building and investments in infrastructures constitute success factors.

Scaling up and sustainability

The project's approaches in involving networks in the implementation of the project activities, and capacity development conducted in promoting FBLS are key for sustainably scaling up the innovations promoted, as is communication on the knowledge and public goods generated and disseminated through dedicated platforms.

RESOURCES

The WaterChannel. Livelihoods from Floods. https://thewaterchannel.tv/dossiers/livelihoods-from-floods/

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4. Conclusion

The many innovative technologies, approaches and tools generated and promoted by PRUNSAR projects and presented in this catalogue provide ready-to-be-adapted and scaled-up solutions to address interlinked development and environmental challenges including food insecurity and malnutrition, climate change, unsustainable NRM and rural poverty, all of which disproportionately affect women and youth.

The dissemination of this catalogue to development practitioners is key for informing ongoing and future investment in these innovations to develop their potential and ensure their application at scale to transform agrifood systems and to contribute to the SDGs.

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