Independent Office of Evaluation

IFAD
Investing in rural people

Technical Innovations for Rural Poverty Reduction

EVALUATION SYNTHESIS

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Evaluation synthesis

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Photos:

Front cover: A beneficiary of the Microfinance and Technical Support Project prepares feed at her chicken farm in Boldi, Bangladesh. She participated in a project-run training programme on proper chicken vaccination techniques and received financial support.
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Back cover: Egypt_West Noubaria Development Project. Amreya, West Noubaria Development Project Head Quarter. Artificial Insemination Center. © IFAD/Marco Salustro (Left); The Agricultural Development Project in Matam, Senegal. The president and treasurer of the Doumga Ouro Alpha Women's Cooperative talk to an agricultural engineer, about the drip irrigation system they have installed in their vegetable field in Doumga village. Every drop of water is used to directly irrigate one seedling or plant. In an environment where water is scarce, the land is dry and every drop of water counts, this method is highly effective (right).
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Foreword

The Independent Office of Evaluation of IFAD has prepared an evaluation synthesis report on IFAD's support to technical innovations for rural poverty reduction. The focus of this synthesis is, specifically, on the programmes or projects that have included innovative technical features.

While the focus of this synthesis is on technical innovation, the synthesis fully acknowledges that innovation is not only about technology. Therefore, enabling factors such as social, economic, institutional and policy processes are also reviewed. These aspects will be examined in further depth by the ongoing Corporate-level Evaluation on Innovation and Productivity Growth for Inclusive and Sustainable Agriculture, for which this synthesis serves as a building block.

From the outset, IFAD recognized that it could play a catalytic role in reducing rural poverty through investments in agriculture and rural development. This made IFAD unique as both a specialized United Nations agency and an international financial institution. Since the mid-1990s, IFAD has made concerted efforts to incorporate innovation into its key policy and strategy documents. IFAD interventions typically focus on how successful local initiatives will sustainably leverage policy changes, additional resources and learning to bring the results to scale.

IFAD usually plays a facilitating role, linking the mode of dissemination, the implementing partners and the enabling environment. The synthesis highlights the important role of partnerships for innovations that require new knowledge and skills. Technical support is often provided through IFAD grant funding.

This synthesis draws the important distinction between productivity-enhancing innovations and transformative innovations. Transformative innovations are those that bring a major change to farming system structures and functions by introducing new enterprises or radically different ways of farming and post-harvest technologies. Of the innovations identified in the reviewed sample projects, 28 per cent are considered transformative. Transformative innovations are considered riskier, carry a higher level of technical change and usually require broader packages of support to be successful.

Transformative innovations can be more disruptive, with the potential for higher rewards; however, they require higher investments in resources and knowledge. If IFAD wishes to promote substantial changes in income and food security, innovations of a transformational nature are needed to tackle the root causes of hunger and malnutrition within the Agenda 2030.

The synthesis recommends that IFAD should recognize and reward such innovative efforts that are transformational but riskier. A working environment that rewards risk-taking is at odds with a view that successful adoption is the only satisfactory outcome. A clearer distinction between the more routine productivity-enhancement and less common transformational innovations would help to understand and manage the change that is being promoted and better target the innovations.

The synthesis also recommends that innovations should be more systematically monitored and evaluated, to enable learning from the experiences. It is important to understand how different packages of innovation have worked and how the enabling support functioned. Interventions can move on from being part of agriculture's natural cycle of learning and advancement to a more transformative change.

I hope that this report will be useful to guide IFAD's future support of innovations for rural transformation.

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IOE also thanks IFAD Management and staff from several departments and divisions who provided insights and comments on the draft report.

Contents

Abbreviations and acronyms

APR	Asia and the Pacific Division (IFAD)
ATO	assistant technical officer
AWD	alternate wetting and drying
CGIAR	Consultative Group for International Agricultural Research
CLE	corporate-level evaluation
CSPE	country strategy programme evaluation
ENRM	environmental and natural resource management
ESA	East and Southern Africa Division (IFAD)
ESR	evaluation synthesis report
FAO	Food and Agriculture Organization of the United Nations
FFS	farmer field school
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
ICT	information and communication technology
IOE	Independent Office of Evaluation of IFAD
IPM	integrated pest management
IRRI	International Rice Research Institute
IWM	integrated weed management
LAC	Latin America and the Caribbean Division (IFAD)
LCC	leaf colour chart
M&E	monitoring and evaluation
MFI	multilateral financial institution
MTR	mid-term review
NEN	Near East, North Africa and Europe Division (IFAD)
NGO	non-governmental organization
NRM	natural resource management
PAPSTA	Support Project for the Strategic Plan for the Transformation of Agriculture
PO	partner organization
POG	pass on the gift
PPA	project performance assessment
PPE	project performance evaluation
PPP	public-private partnership
SDG	Sustainable Development Goal
SHG	self-help group
SRI	system of rice improvement
ToC	theory of change
USGs	urea super granules
VAHW	village animal health workers
WCA	West and Central Africa Division (IFAD)
WFP	World Food Programme

Executive summary

Introduction

1. **Background.** Since the mid-1990s, IFAD has made concerted efforts to incorporate innovation into its key policy and strategy documents. In 2004, IFAD introduced the Initiative for Mainstreaming Innovation, in an effort to explicitly focus on innovation and mainstream it in its processes. IFAD's Strategy on Innovation was developed in 2007. The 2010 corporate-level evaluation on "IFAD's capacity to promote innovation and scaling up" revealed that the Fund had paid relatively more attention to (and found more success in) innovative solutions in social engineering and institutional arrangements (e.g. promoting participatory approaches to planning and resource allocation), rather than in agricultural practice.

2. **Objectives and scope.** This evaluation synthesis report (ESR) examines the support that IFAD has provided to technical innovation for rural poverty reduction in recent years. The focus of this synthesis is specifically on the operational part of IFAD's programme, and within this, on the programme/project level of interventions that have included innovative technical features. The ESR seeks to analyse what technical innovation consists of, in IFAD's portfolio, and what is known about the nature of interventions, their uptake, effectiveness and impact. The timeframe covered by this ESR is 2010-2018.

3. The objectives of this synthesis are:

   i) to identify technical innovation practices and lessons learned about the potential for success and scaling up that can inform future IFAD interventions; and

   ii) to identify key factors enabling (or hindering) innovation, within the limitations of the available evaluative evidence.

4. **Data sources.** The ESR derives its lessons primarily from existing evaluative evidence. The synthesis followed a progressive sampling approach to identify successful innovation practices to be analysed in further depth. The final sample of 57 evaluations included: 25 country strategy and programme evaluations, 22 project performance evaluations/assessments, 3 impact evaluations, and 7 ESRs. Four case studies were undertaken to explore in more detail the factors that enabled or hindered innovation, such as country policies and institutional frameworks, through a review of a wider range of project documents or country analyses.

5. **Theory of change**. Consideration of IFAD's theory of change for technical innovation initially reflected a model that envisaged a problem-solving cycle of interaction between farmers' needs and new technical solutions. Actual practice is more complicated, with three distinct iterative cycles to identify the scope, plan the innovations and their dissemination, and provide a supportive framework. The change process for technical innovation involves a complex interaction of feedback loops, associated with adjustment of the technical innovation during piloting, adaptation and learning.

Findings

6. This ESR focuses on technical innovation. Technical innovation is the introduction of an idea, practice or object that is perceived by an individual or other entity as new or improved. It can involve inputs, products, productive processes, or complementary process and institutional innovations, e.g. in marketing, which accelerate adoption and magnify impact. Technical innovation means applying ideas, knowledge or practices that are new to a particular context with the purpose of creating positive change. Some technical innovations might require

complementary changes to institutional or social arrangements to facilitate their adoption and magnify their impact. Very often, innovations are grouped or bundled; their promotion in isolation is much less common.

7. **Intervention types.** Within the sample of 57 evaluations, the synthesis identified 416 innovative interventions. Most of the innovations belong to three categories: crop types, livestock and crop management.

8. The two most important changes were: (i) productivity enhancing; and (ii) transformative; these made up 56 per cent and 28 per cent of the sample, respectively. The distinction between productivity enhancing innovations and transformative innovations is important. Productivity enhancing innovations are those that improve returns to land, labour and capital by means of incremental changes to the farm business, including forestry and fisheries. Transformative change, on the other hand, includes innovations that bring a major change to farming system structure and function by introducing new enterprises or radically different ways of farming and post-harvest technologies. Transformative innovations are considered higher-risk and usually require broader packages of support to be successful.

9. **Productivity enhancing practices.** A successful practice is linking field demonstrations with access to microcredit. A less common practice is to introduce applicator machines to overcome labour constraints. Introduction of fertilizer and pest management practices requires a package of support to work. This includes enhanced efficiency of fertilizer use and adoption of organic products, and tackling pests and weeds through integrated methods. Improved use of fertilizers and integrated pest management/integrated weed management bring quick and visible returns from lower costs or improved yields.

10. The system of rice improvement (SRI) is a combination of practices chosen to meet the needs of the context. It can include the following: transplanting of seedlings, improved variety use, use of compost and soil nutrient management, weed management and crop establishment. SRI has been popularized across three regions: Asia and the Pacific, East and Southern Africa, and West and Central Africa.

11. The introduction of improved or quality seeds must ensure that an appropriate framework is in place, with guarantees of quality, continuity of partnership with research institutions to provide foundation material, arrangements for contracting or authorizing outgrowers and a procedure for collection, grading and distribution.

12. **Transformative practices.** The introduction of new crops helps to diversify production but exposes farmers to new risks. Being able to organize farmers and provide access to market information is critical for safeguarding farmers' interests and achieving an equitable relationship between farmers and buyers, in many cases.

13. Improved use of water requires low-cost technology and materials that are readily available. Drip and sprinkler irrigation improve efficiency; small-scale irrigation (SSI) with manual pumps and spate irrigation can transform crop options, as can water harvesting in micro catchments for fodder shrubs and fruit trees.

14. Innovations for soil and water conservation and climate change adaptation are labour-intensive and generate little extra income; however, they can also reduce production costs and enhance food security. Introducing new plants and trees provides additional sources of grazing or fodder and can reduce soil erosion; combined with nitrogen-fixing varieties and composting, it improves soil structure and fertility. Water harvesting and water infiltration can extend growing seasons and enable crop diversity.

15. Alternative sources of energy have a potential to transform the household's energy efficiency and bring about significant health benefits, by reducing drudgery and smoke in the kitchens. Bio-digesters help dispose of waste products and reduce wood consumption; however, they present substantial limitations in terms of access to raw materials, demands on labour and suitable climate, and are therefore likely to be a niche technology, at best.

16. **Targeting innovations.** Most innovations are not specifically targeted, although there are significant examples, such as improved crop varieties and certain new crop types, in which innovations were directed to poorer farmers and communities and to women. While some innovations are clearly only more suitable for better-off farmers (particularly, those requiring access to land and some livestock innovations), overall, IFAD's technical innovations are geared towards farming households that are neither very poor nor better-off.

17. **Partnerships for innovation.** Research partnerships (with national and international research centres) mainly supported the introduction of new or improved crops. Partnerships with the Consultative Group for International Agricultural Research can catalyse important innovations; however, often, the partnership is confined to the project duration and does not evolve into long-term partnerships. Partnerships with the private sector focused on introduction of cash crops and product processing.

18. One third of the evaluations reviewed refer to grant-funded activities towards technical innovation. Grants play an important role in supporting technical innovations and were used to deliver a diverse set of activities for technical development, piloting, dissemination and knowledge management.

Key lessons

19. **A collective set of technical innovations, such as an SRI, provides a simple focus for project design**, even though the component parts can, and should, vary according to local needs. Introducing collective sets of technical innovations for rainfed field crops, vegetables, livestock and others facilitates project design, implementation support, and learning.

20. **Technical innovations to promote value chain development require careful preparation.** Plans to add value by increasing production to create a marketable surplus, either through improved productivity or by transforming farm enterprises and processing, must take account of markets, and in particular of: provision the of inputs, sale outlets, buyer concentration, farmer negotiating power, and consumer demands, while avoiding over-dependency. With new products, these factors can be difficult to determine in advance.

21. **Environmental damage may arise from innovations supporting both diversification (new crops) and asset growth (livestock numbers), as well as productivity.** Productivity improvements can stimulate more intensive use of inorganic fertilizers and pesticides and overgrazing by livestock. Poorly planned water use brings the potential for salinization; and some processing, such as for cassava, generates effluent that has to be controlled to prevent environmental damage.

22. **Effective partnerships are essential for input supply, technical advice, group development, dissemination and marketing.** Innovations can bring extensive demands for support from government agencies, research institutes, NGOs and private sector entities. Critical functions such as seed supply are difficult to establish. Negotiating shared objectives, resource availability, priority actions and supportive policies with partners is challenging.

23. **Managing successful innovation demands transdisciplinary skills.** Understanding the physical and social context, how best to engage and work with partners, the most effective mode of delivery and how to organize participating

farmers brings a need for skills that can outweigh the technical aspects of the innovation.

24. **The simpler the innovation, the greater the chance of it being sustained**. Low-cost, low-tech innovations with short input supply and marketing chains, local manufacture and minimal maintenance are the most viable. Some apparently simple technical innovations can be more complex to manage and sustain. Sustainability is less certain where government ownership is in doubt, partnership support is narrowly tied to projects, and technology is dependent on scientific support. Functioning local organizations and strong market connections all help sustain relationships and manage risks.

25. **Scale must be considered when introducing innovations.** Some innovations only show their benefits when implemented at scale. Others, such as post-harvest and processing equipment and machinery, can be difficult to manage at scale.

Conclusions

26. **Technical innovation, defined as the introduction of a process or product that is new to the context, is mainstreamed in IFAD** and examples can be found in all aspects of the portfolio. According to this definition, the majority of project interventions are innovative. Most technical innovations aim to enhance productivity and offer low-cost, low-tech marginal improvements in cropping practice and animal health. They are classic interventions in agricultural development that entail low risk and are well suited to the needs of many farmers. Most innovations are of low technical complexity and are designed to bring incremental changes to the farm business.

27. **A smaller number of innovations are transformative**. Transformative innovations are more risky and they carry a higher level of high-tech change. They can be more disruptive, with the potential for higher rewards; however, they require higher investments in resources and knowledge. The distinction between productivity and transformation is important if IFAD wishes to promote substantial changes in income and food security. Innovations of a transformational nature are required to tackle the root causes of hunger and malnutrition within the Agenda 2030.

28. **The majority of technical innovations are not targeted to specific groups.** Most technical innovations are geared towards the "average" farming household in any location, that is, neither very poor nor better-off. There are some exceptions for livestock and certain other innovations, which are more suitable for farmers with access to land and finance.

29. **Accompanying support and partnerships are essential for introducing innovations that require new knowledge and skills.** IFAD is well positioned to provide this type of support, as it is seen as a strength of IFAD's approach across the portfolio. IFAD usually has a facilitating role, linking the mode of dissemination, the implementing partners and the enabling environment. Grant-funded projects are the most frequently used mechanism for research and technical development; however, they are often not systematically linked with practical application and adaptation.

30. **Impact tends to derive from a package of innovation measures, and not from a single element.** Innovation is inherently uncertain. Some technologies take time to become established. These results may certainly reflect well on the projects; after all, income is a function of more factors than innovation alone. A positive impact on household incomes was found in 20 per cent of all projects. A higher proportion (27 per cent) experienced improvements to food security and productivity.

31. **Many innovations related to agricultural practices are potentially significant for natural resource management and climate change**

mitigation; however, the associated risks must be carefully managed. Some technical innovations had positive impacts on the environment, natural resource management and climate change aspects, such as drip irrigation, green manure; others may have unforeseen negative longer-term consequences, such as irrigation and cassava processing.

32. **IFAD deals with a highly diverse portfolio, with few repeat examples of many innovations.** A limited number of specific technical innovations were replicated in several locations. Otherwise, an extensive range of other innovations responds to local contexts and needs. The challenge to scaling up derives from the multiplicity and variety of innovations, such that there are few straightforward indications on which solutions are successful and for whom.

Recommendations

33. **Recommendation 1: Enhance focus on transformative practices within IFAD's approach to technical innovation, while continuing to promote low-risk improvements to productivity for the majority of poor smallholder farmers.** IFAD should recognize and reward innovative efforts that are transformational, but more risky. A working environment that rewards risk taking is at odds with a view that successful adoption is the only satisfactory outcome. A clearer distinction between the more routine productivity enhancements and less common transformational innovations would help to understand and manage the change that is being promoted and better target the innovations. Some interventions evolve from being part of agriculture's natural cycle of learning and advancement towards a more transformative change. Project design would have to anticipate the point at which innovations become transformative and accordingly plan for dissemination and enabling support. Scaling up must be mainstreamed in project design to maximize impact and returns to innovation.

34. **Recommendation 2: Systematically monitor, evaluate and learn from innovations.** Far too many innovations are underreported, which leads to learning being lost. This observation applies to both loans and grants. There is no systematic framework for evaluating innovation in project and country evaluations. Simple measures, such as using adoption rates in a uniform and consistent manner, can be very revealing. There is a need to address relatively simple questions about adoption rates, as well as why innovations did or did not work in the specific context. In addition, it is also necessary to provide better documentation when different packages of innovation work. Evaluation must understand the adoption and adaptation process, and how the enabling support functioned. More challenging innovations may benefit from a counterfactual model to demonstrate outcomes. A narrow focus on impact avoids the more practical questions on why an innovation works in certain settings, for some participants, and not in and for others.

35. **Recommendation 3: Use the forthcoming CLE to explore IFAD's readiness to promote transformative innovations.** This synthesis highlights the distinction between productivity enhancement and transformative change. A deeper exploration of the extent to which IFAD as an organization is set up to actively support transformative innovations should be undertaken by the Independent Office of Evaluation of IFAD. This would include an assessment of the risk culture prevailing in the organization.

IFAD Management Response

1. Management welcomes the Independent Office of Evaluation of IFAD's (IOE) evaluation synthesis report (ESR) on IFAD's support to technical innovations for rural poverty reduction. Management is pleased to note that IOE is devoting attention to the important topic of innovation, which is in line with the priority being given to it at the corporate level, as evident through the establishment of the Change, Delivery and Innovation Unit; the Private Sector, Advisory and Implementation Unit; and the recent launch of an IFAD innovation challenge.

2. Management appreciates IOE's efforts in trying to capture lessons on technical innovations in isolation, it although recognizes there are limitations. Management would like to raise the following two issues, which were also highlighted earlier in Management's comments on the approach paper:

   a. most innovations are hybrid in nature and not only technical. Therefore, viewing them on their own risks being reductive. There may be significant innovations in the social, economic, institutional and policy processes that are not only enabling factors – as considered by the ESR – but innovations in themselves.
   b. as noted by IOE in the ESR report, an "important limitation is the limited depth of the analysis included in IOE evaluations with regard to innovation". As the synthesis evaluations are entirely based on past IOE evaluations, Management believes it is important to recognize that reaching strong conclusions based on the limited evidence captured on technical innovations is challenging.

3. While the ESR has identified isolated cases of good practices in technical innovations as well as some missed opportunities, Management believes that the corporate-level evaluation is better positioned not only to validate the conclusions of the ESR but also to provide a more holistic and reliable analysis on innovations. In this context, the ESR can serve as an important building block for the CLE.

4. Management looks forward to the continued engagement with IOE on the CLE and believes that the lessons generated will help Management learn from what has worked, what has not and the underlying reasons for both outcomes, to contribute to the Fund's evolving approach to supporting innovations for inclusive and sustainable smallholder agriculture.

Recommendations

5. Management welcomes the three recommendations of the ESR and believes they are relevant to enhance IFAD's work in promoting technical innovations in its programme of loans and grants. While informing future project design, the recommendations should also be incorporated into the ongoing corporate-level evaluation on IFAD's support to innovations for inclusive and sustainable smallholder agriculture.

6. Management's detailed response to each recommendation follows below.

7. **Recommendation 1: Enhance focus on transformative practices within IFAD's approach to technical innovation, while continuing to promote low-risk improvements to productivity for the majority of poor smallholder farmers.**

8. **Agreed:** Management agrees with the need to balance the support provided to innovative approaches, with the need to provide low-risk interventions for the majority of rural smallholder farmers, as they are most at risk and least able to access and invest in new innovations. Management will ensure that more effort is

made to identify and analyse potential innovations for rural transformation during the COSOP and programme design processes.

9. Management will focus on ensuring that innovation is not seen as a single input in the agricultural value chain but as an integrated approach, i.e. moving from seeing seed as an innovation, to looking at innovations in the farming system, as farmers invest in and adopt climate-resilient, sustainable and profitable farming livelihoods.

10. **Recommendation 2: Systematically monitor, evaluate and learn from innovations.**

11. **Agreed:** Management agrees with the need for increased monitoring and evaluation of innovation, and programme results more generally. In this ESR, there is some overlap in the use of the terms "innovation" and "adoption". As per the 2017 ESR on Scaling-up, Management requests that these two terms be defined accurately and separately, as innovation is not adoption. Innovation is a process, and adoption (or no adoption) is the result of this process.

12. Management will continue to focus on improving the design quality of projects and for closer technical implementation support, so that data can be collected, analysed and used for improved management. In fact, this maybe one area where innovative approaches can be used in the programme of loans and grants to collect accurate and timely field data via information and communication technology (ICT4D) approaches.

13. Management would like to highlight, in agreement with the ESR's observation, that this aspect is being given increasing attention in IFAD. The current ICT4D strategy development will, for the first time, give IFAD a framework for the use of ICT to improve targeting, monitoring and evaluation, management of project data, and project portfolio management.

14. **Recommendation 3: Use the forthcoming CLE to explore IFAD's readiness to promote transformative innovations.**

15. Not applicable: This recommendation has been made to IOE, and therefore has not been considered by Management.

The Char Development and Settlement Project – Phase IV in Bangladesh. This latrine is among the 26,909 constructed by the Department of Public Health Engineering in the chars for water supply and sanitation.

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Technical innovation for rural poverty reduction
Evaluation synthesis

I. Introduction

A. Background

1. This evaluation synthesis report (ESR) examines the support provided by IFAD to technical innovation for rural poverty reduction in recent years.

2. The world is facing unprecedented global challenges that affect the sustainability of food and agriculture systems, and thus the livelihoods of millions of small-scale farmers worldwide. These challenges include natural resource depletion and environmental degradation, an ever-increasing world population, the effects of climate change, and weak institutions. These global challenges pose serious threats to the ability to achieve the right to adequate food and the fundamental right of every person to be free from hunger.

3. While previous efforts centred on boosting agriculture to produce more food, today's focus lies on tackling the root causes of hunger and malnutrition through transformative changes to our food system (FAO, 2018).

4. Agricultural development demands, and depends on, functioning formal and informal innovation systems that generate effective technical and non-technical innovations. Innovation is a major source of improved productivity, competitiveness and economic growth in advanced and emerging economies. Innovation also plays an important role in creating jobs, generating income, alleviating poverty and driving social development. However, the challenges imply that technology for development must go well beyond simply raising yields, to seek to save water and energy, reduce risk and improve product quality to protect the environment, all tailored to gender differences (World Bank, 2008).

5. It is within this livelihood approach, and a broader understanding of the concept of innovation, that this ESR analyses IFAD's work on technical innovation.

B. Synthesis objectives, key questions, scope and definition

6. The focus of this ESR is specifically on the operational part of IFAD's programme, and within this, on the programme or project level of interventions that have included innovative technical features. The ESR seeks to analyse what is technical innovation, in the context of IFAD's portfolio, and what is known about the nature of interventions and their uptake, effectiveness and impact. The rationale behind this narrower focus on IFAD's work on technical innovations is twofold. First, the corporate-level evaluation (CLE) on IFAD's Capacity to Promote Innovation and Scaling Up (2010) found that "the Fund had paid more attention to innovative solutions in social engineering and institutional arrangements (e.g. promoting participatory approaches to planning and resource allocation) rather than agriculture". This ESR therefore addresses the need to take stock of IFAD's concrete experience in promoting technical innovations in order to learn what has worked and for which parties. Analysis of the uptake of technical innovations can orient future innovation packages in a more effective way. Second, the Independent Office of Evaluation of IFAD (IOE) will conduct a CLE on Innovation and Productivity Growth for Inclusive and Sustainable Agriculture in 2019. The CLE will provide a wider assessment of IFAD's work on innovation and this ESR will serve as a building block for the evaluation.[1] While this ESR focuses on technical

[1] The CLE will, however, have a much broader scope and examine IFAD's role in: (i) strengthening the internal capacity to identify innovations that respond to productivity; (ii) addressing the social and environmental constraints faced by rural people; (iii) incorporating and testing innovations within projects; (iv) learning from these innovations; and (v) scaling-up successes for expanded and sustainable impact. It will also ascertain IFAD's role in supporting countries' efforts to scale-up successful pro-poor rural development models, widen their geographical coverage and reach larger numbers of people.

innovation, it fully recognizes that innovation is not only technology, which, applied in isolation, rarely works. Therefore, enabling factors – which include social, economic, institutional/organizational and policy processes – are also assessed. Furthermore, most of the ESR focuses on direct agricultural poverty reduction, with limited consideration of multipliers for non-farm employment, economic growth and poverty reduction as consequences of effective technical innovation.

C. Objectives

7. The ESR focuses on learning, more than on accountability. It derives its lessons primarily from existing evaluative evidence. The objectives are:

   a) to identify technical innovation practices and lessons learned about the potential for success and scaling up that can inform future IFAD interventions;

   b) to identify key factors enabling (or hindering) innovation, within the limitations of the evaluative evidence available.

8. **The review of the evaluations was guided by the following detailed review questions:**

   a) Relevance: to what extent was the innovation pro-poor? How relevant were the innovation strategy and the choice of partners?

   b) Effectiveness: to what extent were the expected results achieved? Were the associated financial, institutional and social interventions also innovative? In what ways has the innovation been scaled up? Which innovations have worked, and under what circumstances? What are the factors explaining success?

   c) Impact: what is the impact of the technical innovations involved on rural poverty?

   d) Sustainability: which practices and results have turned out to be sustainable? What were the factors supporting sustainability?

   e) Lessons learned: what were the practices that worked (or did not work) and what lessons can be learned?

   f) In addition, IFAD-specific criteria on scaling up, on the environment and natural resource management (ENRM), and on gender equality were applied.

9. **Scope.** The time frame covered by this ESR is 2010 to 2018. The analysis starts from 2010, following the completion of the CLE on IFAD's Capacity to Promote Innovation (2010), which covered an analysis of 30 completed projects evaluated by IOE between 2004 and 2008. Typically, the projects evaluated during this period were designed 8 to 10 years earlier. Some data refer to periods prior to 2010 (e.g. the Annual Report on Results and Impact of IFAD operations ratings) to provide a historical perspective.

10. **Definition of innovation.** In the discussion of innovation theory and practice, this ESR recognizes that the concept of innovation has been clearly distinguished from those of research and invention, in that innovation can – and often does – involve the dissemination of existing technologies in settings where they did not exist before. Schumpeter (1939) states that "innovation is possible without anything we should identify as invention, and invention does not necessarily induce innovation".

11. IFAD has adopted a broad definition of the term "innovation": as per the 2007 innovation strategy, innovation is "a process that adds value or solves a problem in new ways thereby making the distinction between disseminating something new in a given context, not as something new in absolute terms. The strategy further specifies that in order to qualify as an innovation, a product, idea, or approach needs to be "new to its context, useful and cost-effective in relation to a goal, and be able to 'stick' after pilot testing."

12. More recent definitions have extended this to include "what is used and has resulted in substantial social and or economic benefit to the user" (FAO, 2014). In short, innovation is not simply a synonym for something new, but rather a process, product or arrangement that allows for new benefit when it is used. Recombination and use of existing knowledge may also classify as innovation.[2]

13. This ESR focuses more narrowly on technical innovations. In reality, however, many IFAD-promoted innovations will be hybrids of technical innovation supported by complementary process and institutional innovations, which enable or add impact to the technical innovation.[3] Farmer field schools (FFSs) are examples of such hybrids, as they are often innovative ways of working and can be used to introduce new agricultural practices and technical innovations.

14. Therefore, for the purposes of this evaluation, a modified definition of the term will be used. The definition is drawn from the Inter-American Institute for Cooperation on Agriculture, which in turn adapted it from the OECD 2005 Guidelines for Collecting and Interpreting Innovation.

Box 1
A modified definition

> Technical innovation is the introduction of an idea, practice or object that is perceived by an individual or other entity as new or improved. It can involve inputs, products, productive processes, or complementary process and institutional innovations – e.g. in marketing – that accelerate adoption and magnify impact. Technical innovation means applying ideas, knowledge or practices that are new to a particular context, with the purpose of creating positive change. Newness to context is a key feature, as the innovation may be widely practiced elsewhere; however, it is new to a particular setting. Such change could be substantial (a large change or improvement) or cumulative (small changes that, together, produce significant improvement). Some technical innovations may require complementary changes to institutional or social arrangements to facilitate their adoption and magnify their impact. Very often, innovations are grouped or bundled; it is much less common for them to be promoted in isolation.

Source: Adapted from the Organisation for Economic Co-operation and Development 2005 Guidelines for Collecting and Interpreting Innovation.

15. The emphasis on innovation being considered from the point of view of the individual, household or community decision maker is important. Where planned innovations have been widely adopted in other contexts, extension may be more akin to diffusion. Knowledge about their use means that adopters face better-known risks. Other innovations may involve untested features that must be trialled and further developed. However, both are innovative in their own contexts. This definition is also more detailed than that provided by IFAD, noting that changes can be substantial or cumulative and acknowledging that "soft" interventions – such as institutional and social arrangements – are at times necessary to facilitate the adoption of technical innovations. In addition, the degree of dependence on changes in social and institutional arrangements can be used to identify different classes of technical innovation.

16. This ESR will use this definition of innovation as a conceptual framework. However, aspects regarding which greater clarity or focus is required will also be noted.[4]

D. Evidence base

17. **IOE innovation ratings,** in principle, are a reflection of the effectiveness of project activities with regard to innovation. However, this ESR has used the ratings to a limited extent, as the ratings until 2017 also covered scaling up and therefore reflect not only performance in terms of innovation, but also extend to all types of

[2] A more detailed description of innovation theory is available in annex IX of this ESR.
[3] Interpreted in this way, the technical innovation (TI) concept would embrace three classes: (1) sole TI: (2) TI + essential process and institutional innovation for effectiveness of the TI; or (3) TI + optional complementary process and institutional innovation that magnifies the impact of the TI.
[4] For a review of IFAD's position in relation to partner and comparator agencies, see annex III.

innovation, including those of a more process-oriented nature, which do not fall within the focus of this synthesis.

18. **Methodological approach.** The methodological steps for this ESR included the following: (1) reviewing the relevant literature on innovations to elaborate the theory of change and identify the types of intervention included in the approach paper; (2) reviewing IFAD's background information on innovation; (3) screening available evaluative evidence to determine the sample for review; (4) performing a systematic review of the project sample; (5) elaborating case studies to identify and analyse successful innovation practices, as well as those that failed; (6) developing a typology of innovation practices; (7) engaging in a comparative analysis of innovation practices (including those of other organizations)[5]; and (8) synthesizing findings according to the IOE evaluation criteria (relevance, effectiveness, efficiency, impact and sustainability).

19. **Sampling approach.** The synthesis followed a progressive sampling approach to identify the successful innovation practices to be analysed in further depth. As a first step, 106 evaluation products conducted within the selected time frame (2010-2018) were identified. A rigorous screening process was carried out to assess the robustness of the evaluation findings with regard to innovation, which led to a final sample of 57 evaluation products being chosen. The screening criteria guiding the sample selection were the following: (i) the technical innovations described; (ii) the reported results in terms of relevance, effectiveness, impact and sustainability and how these results were achieved; and (iii) the enabling and disabling factors described. The final sample of 57 evaluations included: 25 country strategy programme evaluations (CSPEs), 22 project performance evaluations and project performance evaluations/assessments (PPEs/PPAs), 3 impact evaluations (IEs), and 7 evaluation synthesis reports (ESRs). The list of sampled evaluations can be found in annex IV. For referencing purposes, the evaluations were numbered. Whenever this ESR refers to an evaluation, the reference number is reported in square brackets.

20. **Review of the innovation practices sample.** The practices sampled were reviewed systematically using the Nvivo software. Applying the evaluation questions for this synthesis, the data were coded and classified by innovation type (see annex V). For each evaluation product, the relevant excerpts were collated in an Nvivo "memo" file and positive and negative examples were highlighted. In total, 50 memos were created and provided the basis for further analysis. The analysis of the ESRs was undertaken separately and was not captured in memos, as the framework questions were not applicable to the content of these products. Instead, summaries of the sections of relevance to technical innovation were made.

21. **Data cleaning and dataset creation.** Upon completion of the data coding, the data were further reviewed and cleaned. The innovations identified were then listed in an Excel dataset, which functioned as an innovation repository and allowed for quantitative analysis. This repository also enabled identification of areas where there was a sufficient body of evidence.

22. **Case studies** were used for an in-depth review of selected innovations. The four case studies aimed to cover a variety of innovations and explored, in more depth, the factors that enabled or hindered innovation, such as country policies and institutional frameworks. In particular, this was done by reviewing a wider range of project documents and country analyses, that would be able to shed light on relevant contextual issues.

[5] An in-depth analysis of the approaches to innovation and benchmarking information adopted by other international financial institutions (IFIs) is reported in annex III to this ESR.

23. **Interviews with staff.** Interviews with country programme managers and other key staff[6] were conducted to inform and discuss preliminary hypotheses before the drafting phase.

E. Limitations

24. **Innovation is a dynamic field.** A challenge has therefore been to assess innovations in such a rapidly evolving context. The prime source of information for syntheses is the evidence found in independent evaluation reports. The scope of this synthesis is therefore limited to the projects and grants covered in the evaluation reports.[7] The sample used here does not exhaustively cover all of IFAD's innovation activities and will not necessarily be a suitable basis for detailed observations on the interaction between types of funding and partnership arrangements, on one hand, and the uptake of innovations on the other. The benefits arise from the ability to draw upon standardized products using a common methodology, which lends confidence to the findings and conclusions. Another major limitation in this respect is linked to the time lag between implementation and the subsequent evaluation, which may exclude more recent advancements made in this area. For example, the sample included a few cases of technical innovation related to information and communication technology (ICT) or that covered the impact of technical innovation on youth. However, the ESR draws on 57 evaluations conducted across all of IFAD's regions, which is by no means a small or restricted sample, and can therefore still shed light on patterns in innovation in IFAD's portfolio.

25. Another important limitation consists in the **limited depth of the analysis included in IOE evaluations with regard to innovation**. Not all innovations identified at the start of a project are systematically covered in the evaluation reports. Similarly, the process of dissemination, adoption and diffusion is not always explored in depth, nor are the relationships with enabling factors – such as social organization, access to finance, provision of infrastructure and partnerships – always evaluated in the context of technical innovation. Last, adoption is not always reported as an output indicator, nor are adoption statistics systematically reported for the initial uptake or for wider promotion across the project area. Screening the quality of the available evidence helped to identify those evaluations that include a sufficient analysis of innovation results as well as of the underlying strategies. However, the available evidence inevitably posed a limitation on the range and diversity of practices that could be reviewed by this synthesis, which specifically meant that the evaluation could not make a comparative analysis of factors enabling or hindering innovation. However, the ESR does present the evidence that is available.

26. A final limitation relates to the effort to **isolate certain innovative practices from the rest of the project,** with a view to determining the impact trail of technical innovations. In reality, many projects in IFAD are multisectoral and specifically identified innovative activities constitute a small part of the project; the success of innovations depend on multiple types of intervention. A challenge has therefore been to establish whether the innovations did or did not lead to the impact described in the reports. This challenge was addressed by only coding and reporting data where links between the innovations and the outputs or impacts were clearly stated.

F. Report structure

27. This report is divided into six chapters. After this introduction, the context of innovation and IFAD's role within it is described (chapter II). Chapter III describes the analytical framework applied for the synthesis, including the typology and the theory of change (ToC) that guide the review throughout the subsequent chapters.

[6] See annex VI for a list of the key people met.

[7] As for grants, this is not considered a major obstacle, because the CLE on the IFAD Policy on Grant Financing found that only a fraction of grants assigned for research actually financed research.

A systematic review of technical innovations according to the applicable evaluation criteria (relevance, effectiveness, impact, sustainability and scaling up) is included in chapter IV. Chapter V presents good practices on technical innovations, the key factors contributing to the success or failure of technical innovations and the lessons learned, while chapter VI draws conclusions and sets out a number of recommendations.

Key points

- This synthesis focuses on IFAD's programme- and project-level interventions that have included innovative technical features, over the period 2010-2018.
- The working definition of "innovation" used in the synthesis is "the introduction of an idea, practice or object that is perceived by an individual or other entity as new or improved. It can involve inputs, products, productive processes, or marketing. It means applying ideas, knowledge or practices that are new to a particular context with the purpose of creating positive change". Certain technical innovations may require complementary changes to institutional or social arrangements, to facilitate their adoption and magnify their impact.
- The synthesis selected a sample of evaluation reports using a progressive sampling approach, which included initial screening of the available evidence as a first step. The final sample included 57 reports: 25 CSPEs, 22 PPEs/PPAs, 3 IEs, and 7 ESRs.
- The synthesis used four standard evaluation criteria to review the technical innovation practices: relevance, effectiveness, impact and sustainability. In addition, IFAD-specific criteria on scaling up, the ENRM and gender were applied.
- The review questions are presented in annex IV.

II. Corporate processes in support of innovation

A. IFAD's mandate and strategic focus

28. IFAD is the only international financial institution with a specific mandate to reduce rural poverty through investments in agriculture and rural development. It was established as an international financial institution in 1977 to mobilize resources to invest in development opportunities for poor rural people. The Fund works in close collaboration with borrowing country and local communities to design, supervise and assess country-led programmes and projects that support smallholders and poor rural producers.

29. From the outset, IFAD recognized that one of its primary advantages would be its ability to use its resources and institutional capacity to promote the funding and scaling up of activities by forming strong partnerships with cooperating institutions. Through these partnerships, the Fund expected to be able to leverage its own resources and promote a focus on increased food production and the reduction of rural poverty and hunger within the broader international development architecture. In other words, IFAD understood that it could play a catalytic role in agricultural development. This made IFAD unique as both a specialized United Nations agency and an international financial institution.[8]

30. Since the mid-1990s, IFAD has made concerted efforts to incorporate innovation into its key policy and strategy documents. The IFAD Strategic Framework 1998-2000 identified and highlighted innovative pilot projects and programmes in agricultural and rural development (agricultural production, microcredit, rural infrastructure, self-help groups and land tenure) as the Fund's "core business". In line with recommendations of the Evaluation of IFAD's Capacity as a Promoter of Replicable Innovations in Cooperation with Other Partners (2002), senior management took decisions to ensure a strategic commitment to innovation, to be supported by attempts to develop a culture of innovation through staff incentives and training.[9]

31. IFAD placed scaling up at the heart of its Strategic Framework 2002-2006, with the objectives of expanding, adapting and supporting successful policies and programmes and capturing knowledge. The Fund expected scaling up to leverage resources and partners in order to deliver greater results for a larger number of poor rural people, in a sustainable way.

32. In 2004, IFAD introduced the Initiative for Mainstreaming Innovation, in an effort to explicitly focus on innovation and mainstream it in IFAD's processes. The Initiative was directed at building capacity to promote innovation by allocating funds according to three types of activities: (i) special funds earmarked for organization-wide activities for which competitive funding was not appropriate; (ii) competitive funds to be used over a three-year period to finance innovative projects; and (iii) a small pilot funding facility to provide rapid funding for innovative action. The Independent External Evaluation (2005) reinforced the Fund's focus on innovation, and the IFAD Strategic Framework 2007-2010 emphasized "innovation, learning and scaling up" as one of the Fund's six principles of engagement. The process of innovation and scaling up was considered central to the vision of IFAD's role, and all interventions within IFAD's country programmes were expected to be innovative.

33. IFAD's Innovation Strategy was developed in 2007. The Strategy encourages innovation in practice, focusing on four clusters: (i) building capabilities and understanding of challenges requiring innovation; (ii) nurturing partnerships and facilitating an innovation network; (iii) embedding rigorous innovation processes

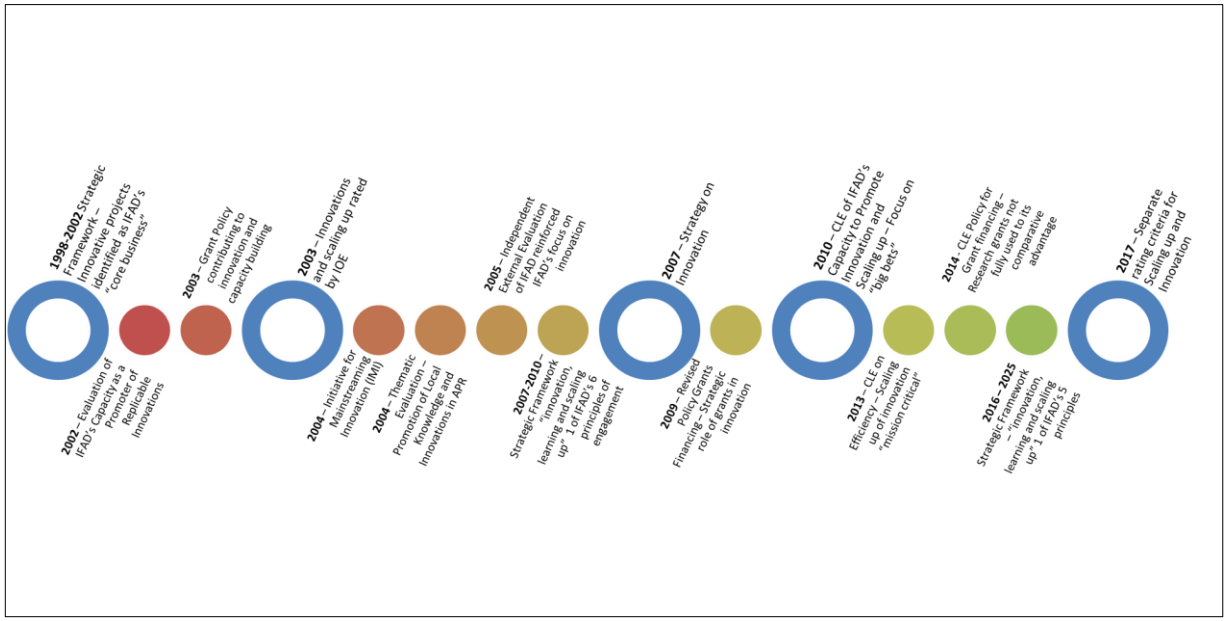
[8] This ESR has examined the policies and evaluation findings of partner agencies to draw comparisons with IFAD. A short description of those documents and the related references can be found in annex III.
[9] IFAD, *IFAD 40 Years of Investing in the Rural Poor* (Rome: IFAD, 2018 [draft]), p. 10.

and the related risk management into IFAD's core business practices; and (iv) facilitating a more supportive organizational environment for innovation.

34. The revision of IFAD's Policy for grant financing in 2009 emphasized the strategic role of grants in innovation and, for the first time, provided an opportunity to involve the private sector in research on and the piloting of innovations for replication and scaling up through investment projects. These principles were reaffirmed in the further revision of the policy in 2015.

35. The IFAD Strategic Framework 2016-2025 emphasized, once again, the triad of innovation, learning and scaling up as one of five principles for engagement[10] in a "bigger, better and smarter" fashion. IFAD aims to broaden successful pro-poor rural development models, widen their geographical coverage and reach larger numbers of people.[11] The Strategic Framework 2016-2025 recognizes knowledge management and South-South and triangular cooperation as key elements for the organization's development effectiveness, and IFAD has subsequently developed a Knowledge Management Action Plan (2016-2018)[12] and defined its approach to South-South and triangular cooperation.

Figure 1
Time line on innovation in IFAD



Source: IOE.

36. IFAD's role can be considered to be predominantly that of a matchmaker, rather than that of an entrepreneur. In other words, IFAD's role is to identify a need, put forward possible solutions from existing knowledge, source partners for technical support and adaptation, and provide the necessary enabling support to create a conducive environment. This synthesis directly examines IFAD's achievements in introducing new technologies into farmers' fields, ready for scaling up.

B. Innovation within the 2030 Agenda for Sustainable Development

37. Given its mandate to eradicate rural poverty and food insecurity, the focus of IFAD's work is on achieving Sustainable Development Goals (SDGs) 1 (eradicating extreme poverty) and 2 (eradicating hunger). However, the interdependent nature of the SDGs means that SDGs 1 and 2 will not be achieved without contributions towards meeting the other SDGs. According to the IFAD Strategic Framework

[10] The four other principles are: targeting; empowerment, gender equality and partnerships.
[11] IFAD Strategic Framework 2016-2025, p. 20.
[12] Currently under revision.

2016-2025, in addition to SDGs 1 and 2, IFAD contributes particularly to SDGs 5 (gender equality), 8 (decent work and economic growth), 10 (reduced inequalities), 13 (climate action) and 15 (life on land). Additionally, through its work to foster inclusive, diversified and productive rural economies – including in the areas of agribusiness and rural-urban linkages – IFAD's work also contributes to SDGs 9 (industry, innovation and infrastructure) and 11 (sustainable cities and communities).

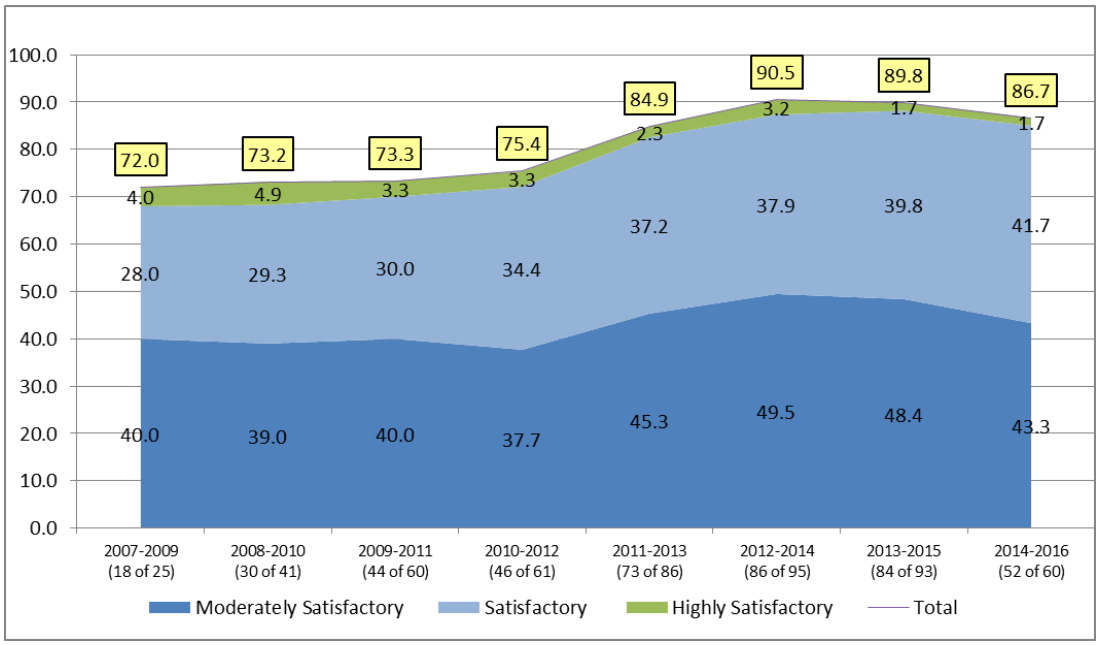
38. The 2030 Agenda recognizes innovation as a cross-cutting element that can reorient the unsustainable development trends currently prevailing. The Agenda highlights, in particular, the potential of innovation in developing countries, which is aimed at fostering sustainable patterns of consumption and production and accelerating the achievement of the SDGs. Recognizing the importance of new technologies to accelerate achievement of the SDGs, the United Nations Secretary General has recently developed a Strategy on New Technologies (2018).

C. IFAD ratings

39. **IOE innovation performance ratings.** IOE has been rating innovation together with scaling up since 2003. However, in 2010, an effort was made to devote further attention to the assessment of scaling up, given its importance in ensuring a wider impact on rural poverty. Therefore, a number of specific questions were added to the IOE Evaluation Manual to better reflect scaling up. As a follow-up to the recommendations of the ESR on scaling up, IOE began rating innovation and scaling up separately in 2017.

40. As may be seen in figure 2, IFAD's contribution to the promotion of innovation has been improving since 2009, but has been slightly deteriorated since 2013, when considering three-year averages. It is important to note that this rating reflects both technical and non-technical innovation processes. In fact, the majority of statements on innovations refer to the latter.

Figure 2
Innovation, by year of completion[13]
Percentage of projects rated moderately satisfactory or better by three-year moving period (PCRV/PPE data)



Source: IOE evaluation database, March 2018.

[13] When conducting trend analyses on the separated criteria, the 2018 Annual Report on Results and Impact of IFAD operations assigns the rating given under the original combined criteria for past evaluations.

41. From a regional perspective, the East and Southern Africa Division (ESA) is the only region displaying a good performance in innovation between 2014-2016 and 2013-2015. The Latin America and the Caribbean Division (LAC) and the West and Central Africa Division (WCA) showed a double-digit decrease in percentage points for the same period (-11.9 per cent and -14.1 per cent, respectively).

D. Recent IFAD evaluations with key innovation messages

42. The 2010 CLE on IFAD's capacity to promote innovation and scaling up revealed that the Fund had paid relatively more attention to (and found more success in) innovative solutions in social engineering and institutional arrangements (e.g. promoting participatory approaches to planning and resource allocation) rather than in agricultural practice. Furthermore, despite IFAD providing a fair amount of grant resources for agricultural research to develop innovative low-cost agricultural technologies that could lead to increased productivity and incomes, the result of such research did not easily find their way into investment projects.

43. IFAD's approach to the promotion of innovation was a broad-based one, in which innovation was pursued in a variety of different fields, without a clear focus on priority areas. While this approach allowed for harnessing the creativity and initiative of rural people and local partners, it failed to direct these energies where they were most likely to generate and support innovation. The CLE identified a need for a structured innovation agenda at the corporate level, with a more specific thematic focus. It further identified that the selection of these themes, also known as "big bets", should consider both the areas of agriculture and rural development that could benefit the most from innovative solutions, and those areas in which IFAD already had a proven advantage in promoting pro-poor innovations.[14]

44. The CLE on IFAD's Institutional Efficiency and Efficiency of IFAD-funded Operations (2013) highlighted that in order to reach a higher share of projects that were "satisfactory or better", IFAD needed to place sharper focus on the testing and incubation of creative and innovative technological and institutional solutions to the myriad problems faced by the rural poor, in order to become a global centre of excellence for smallholder agriculture.[15]

45. The CLE went on to state that the approach driven by innovation and scaling-up would require rethinking the nature of the projects supported by IFAD and how IFAD would judge its own performance. Moreover, the evaluation found that in a successful country programme, the majority of projects would be those that "replicate, expand, modify, refine and adapt scalable innovations[16] over time with increasing levels of government and third-party financing but at the beginning of the cycle, where prototype testing was called for, there could be a need for smaller, simpler projects based on lighter preparation up front, but with greater support during implementation". This type of project would involve higher risks but also, potentially, high rewards, and would require a cultural shift away from risk avoidance towards embracing risk management.[17]

46. The 2014 CLE on IFAD's Policy for Grant Financing highlighted that IFAD grants were insufficiently used to pilot the implementation of potential innovations that, if successful, could be considered for scaling up in subsequent IFAD-supported operations. It went on to state that "a potential source of technological innovation (agricultural research grants) is not fully used to its comparative strengths". In fact, the CLE revealed that many research grants were funding microprojects, in which national research and extension agencies supported by IFAD loan projects could have comparative advantages. Furthermore, there was a limit to IFAD's

[14] IFAD, *IFAD's Capacity to Promote Innovation and Scaling up* (Rome: IFAD, 2010).
[15] IFAD, *IFAD's Institutional Efficiency and Efficiency of IFAD-funded Operations* (Rome: IFAD, 2013), p. 15.
[16] The report's use of the term "innovation" is more generic than the definition of the term included in the IFAD 2007 strategy and the interpretation adopted in this ESR.
[17] Ibid.

capacity to absorb research results and knowledge, which further pointed to the need to better establish priorities.[18]

Key points

- IFAD has a long history of supporting innovation through its strategic frameworks and other policies (e.g. grants).
- The 2030 Agenda for Sustainable Development recognizes innovation as a cross-cutting element that can reorient the unsustainable development trends currently prevailing. The Agenda highlights patterns of consumption and production.
- IOE performance ratings of innovation based on three-year averages show an improvement since 2009, but a slight deterioration since 2013-2015.
- A key message conveyed in several evaluations on innovation and related issues emphasizes that IFAD should prioritize and develop a structured innovation agenda at the corporate level, with a more specific thematic focus.

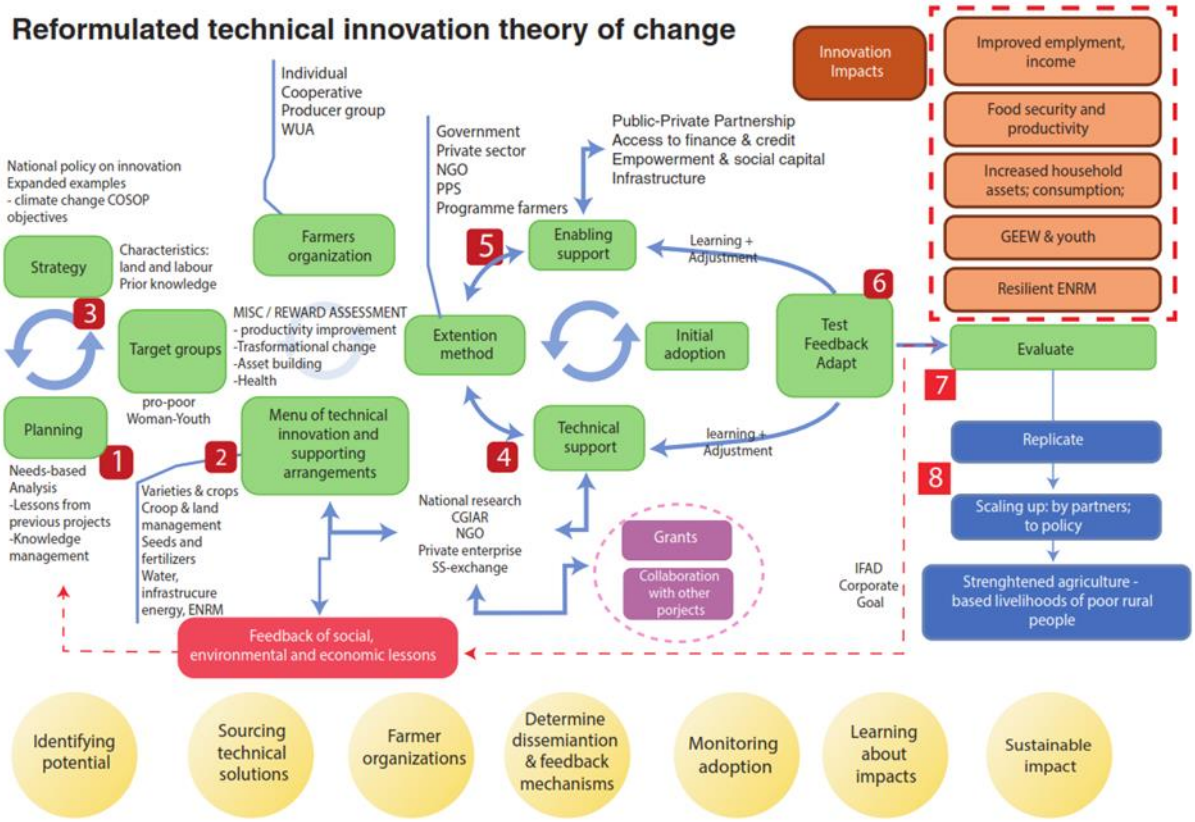
[18] IFAD, *Corporate-level Evaluation on the IFAD Policy for Grant Financing* (Rome: IFAD, 2014), p. 47.

III. Analytical framework

A. A revised theory of change

47. The analytical framework for this synthesis was developed around a theory of change (ToC) and a typology of technical innovations. An initial ToC was developed in the approach paper, derived from IFAD's 2007 Innovation Strategy and informed by IOE's 2002 and 2010 CLEs on IFAD's capacity to promote innovation and scaling up. The findings in this synthesis have allowed for a reassessment of that model and enabled us to put forward a ToC that reflects actual practice (figure 3).

Figure 3
Theory of change



Source: Prepared by IOE.

48. The original theory reflected the literature on innovation by putting forward a model that envisaged a problem-solving cycle of interaction between farmers' needs and new technical solutions. In fact, technical solutions are rarely new; rather, they are simply new to a given context.

49. Actual practice is more complicated, with three distinct iterative cycles to identify the scope, plan the innovations and their dissemination, and provide a supportive framework. The change process for technical innovation involves a complex interaction of feedback loops, associated with the adjustment of the technical innovation during piloting, adaptation and learning. The dotted red line and red box highlight the main feedback loop, while the blue arrows indicate interaction, learning and adjustment.

50. Interventions must meet farmers' needs, but within the framework of national policies and expected challenges (such as climate change). The country strategic opportunities programme (COSOP) might guide the overall direction; lessons from previous projects and experience from IFAD's knowledge management activities may help to inform the choice. Targeting is a process of adjustment, taking into account the people IFAD seeks to support, their assets and their existing knowledge. This should be followed by an assessment of the risks faced by the

target group and the nature of change being introduced; that is, whether it aims to improve productivity, introduce more transformational change, help build individual or community assets, or contribute to improving health.

51. Dissemination brings together the nature of the technical innovation, the preference or otherwise for working though farmer organizations and the method of extension and dissemination. Many innovations are promoted as part of a combination of practices. During implementation, there is likely to be a need for continued technical support, which may require forming a partnership with a research organization or with a private-sector entity. South-South exchange has fulfilled that role in some instances. Grants and direct collaboration with other projects are a way of sourcing that support. The following sections will explore a number of innovations that are enabled by access to finance and credit; others that are dependent on infrastructure; and yet others that benefit from social support to empower participants. The timing of all support provided is important.

52. Far too many innovations are not properly evaluated by IFAD. Few projects report robust evidence for productivity and farm incomes. In this regard, two desirable cycles exist: one for providing rapid feedback during implementation, so that the relevant technology can be modified and dissemination improved; and the other to generate convincing evidence for partners to use and scale up. In some examples, the innovation process takes the form of replicating aspects from one setting to another, often before being scaled up by partners or incorporated in policy. However, there is little evidence that this process is planned and predetermined. Opportunity appears to play a significant role.

53. Learning plays an important role in an effective process. Information from the economic, social and environmental outcomes is considered in the selection of technical innovations and is updated with early results from adoption and periodic evaluations. Evaluations must assess the three decision cycles in this model: matching potential solutions to target groups; the selected implementation content and modalities; the adoption/adaptation practice and fine-tuning from learning.

54. All ToCs rest on assumptions. These are indicated as numbered red boxes in the diagram above and discussed together with the model examined in further detail in annex VIII.

B. Typology of technical innovation

55. All innovations found in the sample were examined and classified according to the extent to which they targeted poorer or better-off farmers[19]; their technical complexity, for which support services were often an essential feature; and the extent to which their implementation required new knowledge through training and human capital development beyond their existing farm practice. This classification, based on the project documentation available, informed the teams' understanding of the nature of change each innovation was enabling and the relationships between technical innovation and process, on one hand, and institutional innovation, on the other.

56. A four-part change typology was identified. The four parts, which are explained in the following paragraphs and illustrated in table 1 below, are:

    a. productivity enhancement
    b. transformative change
    c. asset strengthening
    d. beneficiary health enhancement

[19] The term "better-off" does not imply that the farmers are wealthy or have high resource endowments. Rather, it is used comparatively, to indicate less poor farmers who might have access to land or other capital assets that enable them to participate in certain technical innovations that poorer farmers would not be able to enjoy.

57. **Productivity enhancement** – innovations that improve returns to land, labour and capital by making incremental changes to the farm business, including for forestry and fisheries. This category embraces development interventions that improve performance without radical or transformative changes to the system and reflects, perhaps, the most common examples of agricultural development. They entail a relatively low risk.

58. **Transformative change** – innovations that bring about a major change to the farming system structure and function by introducing new enterprises or radically different ways of farming and post-harvest processing. Although the techniques might be well known in other settings, the nature of the change means that they could involve a higher risk for the participating households. Some innovations might be productivity-enhancing in certain settings; however, they may be transformative if the beneficiaries have never experienced them before or if their adoption removes a critical resource constraint such as access to land, labour availability, technical knowledge or specialist support.

59. **Asset strengthening** – innovations that change capital assets and thereby affect the resources available to the family or participating entity (such as a self-help group [SHG]), and perhaps enable productivity change.

60. **Beneficiary health enhancing** – innovations aimed at reducing drudgery, both at domestic and production level (e.g. drinking water pitchers, ergonomically designed agricultural tools), and improving beneficiaries' health.

61. It has been argued that poor smallholders have five main strategies for escaping poverty, which they mix and blend: (1) intensification through the increased productivity of existing livelihood patterns; (2) diversification from new crops, trees, fish, livestock or value-adding activities, represented by transformative change in the typology proposed here; (3) growth of operated farm or herd size; (4) increased off-farm income; and (5) exit from farming (larger farmers use the same five strategies to increase income). Technical innovations align with one or more of these strategies.[20]

Table 1
Attributes of change

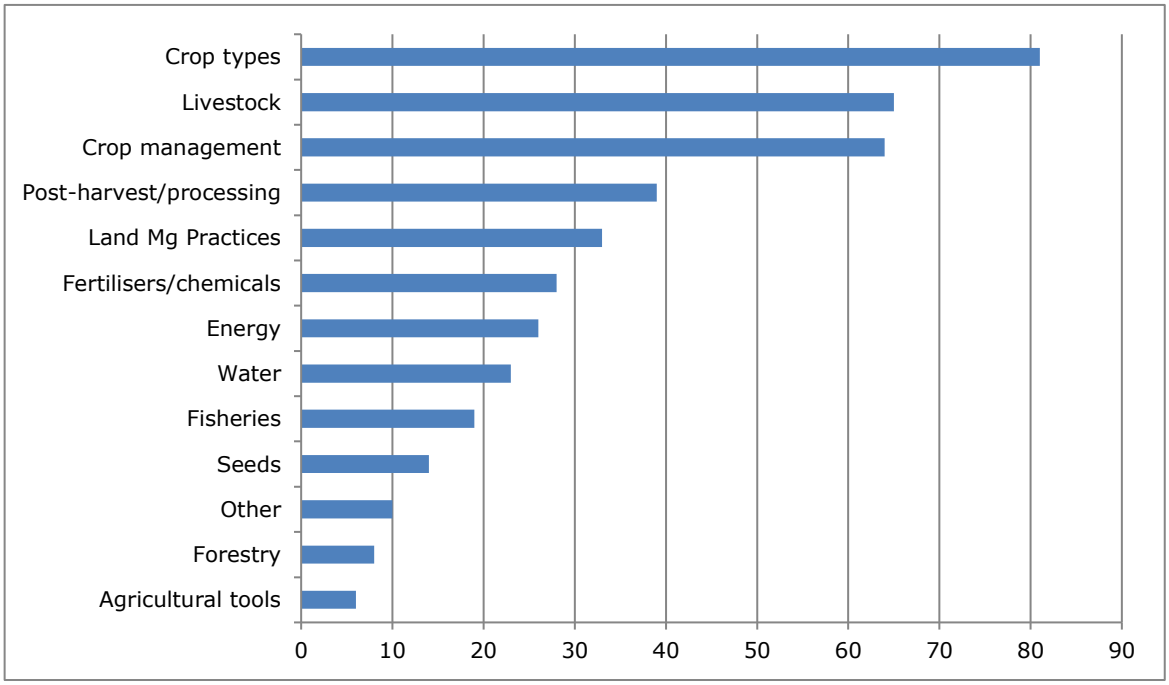
Productivity enhancement	*Transformative change*	*Asset strengthening*	*Health enhancing*
Improved crop varieties	New crop types	Fencing	Alternate Wetting and Drying for reduced arsenic contamination
Organic fertilizers	Bee-keeping	Watershed protection	
Fodder preservation and processing	Sericulture	Soil improvement	
Water-saving techniques	Alternate Wetting and Drying	Perennial and tree crop creation	Ergonomically designed agricultural tools
Improved crop management	Crop processing plants	Fisheries navigation equipment	
System of rice improvement	New product processing	Improved boat building	Lightweight pitchers for drinking water collection
Animal vaccination	Previously unexplored value chain activities	Aquaculture ponds	
Rice huskers	Solar power	Farm mechanization	Improved firewood sources
Home gardening	Biogas	Greenhouses	
Compost preparation	Drip irrigation		
	Rainwater harvesting		

Source: IOE.

[20] See also John Dixon, Aidan Gulliver, David Gibbon, *Farming Systems and Poverty* (Rome: FAO, 2001) and John Dixon, Dennis P. Garrity et al. (eds) 2019 *Farming Systems and Food Security for Africa: priorities for science and policy under global change* (Abingdon: Routledge, 2019).

62. A total of 416 technical innovations were identified through the review.[21] From the analysis, crop types (81), livestock (65), and crop management (64) were the three groupings in which the greatest number of innovations were found (see figure 4).

Figure 4
Number of interventions per technical innovation



Source: IOE.

Key points

- The conceptual framework for this synthesis is captured in a theory of change that presents IFAD's pathway to innovation.
- The ESR worked with 13 categories of technical and enabling interventions.
- Within the sample of 57 evaluations, the synthesis identified 416 innovative interventions. Most of the innovations were identified for three groupings: crop types, livestock and crop management.
- A change framework was identified, with four parts: productivity enhancement; transformative change; asset strengthening; and health enhancement.

[21] The ESR used 13 categories of intervention to classify the innovations: see annex V.

IV. Synthesis findings

63. This chapter presents findings on technical innovation, made according to the applicable evaluation criteria (relevance, effectiveness, impact, sustainability and scaling up). The relevance section (A) focuses on the relevance of the innovations for poverty and the relevance of the choice of partners. The effectiveness section (B) describes the types of innovations identified according to groupings of interventions, reviews the results achieved and analyses some of the key enabling factors. The impact section (C) is structured around five aspects of impact: household incomes and assets; food security and productivity; natural resource management and climate change; gender and youth and human and social capital. In section (D), the sustainability of the technical innovations are discussed. The final section, (E), reviews the innovations according to the IFAD-specific criterion of scaling up.

A. Relevance of innovation strategies

64. This section reviews the relevance of technical innovations according to three evaluation questions: (i) relevance of poverty targeting; (ii) relevance of choice of partners; and (iii) relevance of grants.

Poverty relevance

65. Targeting is one of IFAD's principles of engagement and is central to its mandate of rural poverty reduction. Evidence suggests that strengthening targeting strategies is important for raising overall performance. Targeting is not only defined by the choice of the beneficiaries and achieved by ensuring the delivery of benefits; it is also embedded (intentionally or unintentionally) within the choice of the benefits and the underlying assumptions about the context. Table 2 summarizes the extent to which the different interventions were specifically targeted.

Table 2
Targeting of innovations

Type of innovation	*Innovations targeted at different groups*				*Total number of innovations*
	None or not known	*Better-off*	*Poor*	*Women*	*Innovations*
Crop types	67%	12%	19%	1%	81
Livestock	40%	34%	15%	9%	65
Crop management	58%	20%	16%	3%	64
Post-harvest/ processing	67%	10%	3%	18%	39
Land management practices	70%	18%	6%	6%	33
Fertilizers/chemicals	57%	14%	21%	7%	28
Energy	31%	31%	0%	38%	26
Water	61%	13%	13%	13%	23
Fisheries	47%	42%	11%	0%	19
Seeds	57%	7%	36%	0%	14
Other	80%	10%	10%	0%	10
Forestry	51%	25%	25%	0%	8
Agricultural tools	33%	0%	0%	67%	6
Weighted average	56%	20%	14%	9%	

Source: IOE. Rows may not add up to 100 per cent because of rounding.

66. Although with many interventions, the documentation was insufficiently clear to enable targeting to be categorized, the observations do highlight several strong trends:

- Most innovations (56 per cent) are not specifically targeted beyond the choice of location or the farmers participating in the project design.
- Among the most frequently implemented innovations regarding crop types, livestock and crop management, an appreciable proportion was directly targeted at poor farmers.
- While some innovations were clearly more suitable for better-off farmers (particularly those requiring access to land), overall, the innovations were geared towards the "average" (neither very poor nor better-off) farming household.
- Few innovations – less than 10 per cent in most categories – were targeted specifically towards women (and almost none towards youth).
- Statistics on adoption were inconsistent across projects; often, they were missing. However, from the evidence available, targeting of the poor for crop types and seeds, and of better-off farmers for livestock, was associated with good uptake. The nature of the innovations introduced for post-harvest/processing, energy and agricultural tools led to some targeting of women and successful adoption.
- Evidence about the adoption of targeted land management and fertilizers/chemicals is unclear, as those innovations tend to be interlinked with other crop or livestock technologies and are usually not reported separately.

67. **Positive examples of technical innovations directly benefitting poor farmers were identified in five cases [1, 4, 37, 20, 57]**. In Bangladesh, IFAD

enhanced practices in freshwater fisheries and aquaculture that improved the culture of small fish (*mola*), a major source of protein for poor men and women [1]. Another project in Bangladesh provided research on farming system technologies, with a particular focus on reducing damage to human health and agricultural contamination from arsenic contamination of rice crops [1].

68. In Sri Lanka, the project focus shifted from subsistence agriculture to gradually align itself to changes in the country context, and enabled the support of higher-profit activities that were of relevance to poor and disadvantaged communities. In particular, the project sharpened its focus on: (i) higher-value crops and livestock products; and (ii) linkages to processing and marketing channels within existing value chains (e.g. milk, fruits and vegetables, and technology for seed multiplication [potato and onion; see [35]).

69. **The importance of targeting in livestock projects was emphasized [1, 10, 23, 59, 49].** Forty per cent of livestock innovations were not specifically targeted and 34 per cent targeted the better-off. Some projects pointed to the relevance of small ruminants and livestock for targeting the poor [10, 37]. In Bangladesh, the targeted poor were trained in improved management of poultry and livestock, which contributed to the adoption of improved technologies (e.g. mini-hatcheries) and practices such as vaccination and deworming [37]. In The Gambia, poultry businesses were specifically targeted at young women, who traditionally hold at least a few small ruminants; however, only a part of the businesses were profitable [10].

70. In Uganda [23], positive impacts on household incomes were attributed to small livestock support and roads; however, these were seen mainly for the "not-so-poor" farmers. In Viet Nam, while animal raising led to income increases, new animal breeds did not particularly address the needs of ethnic minorities, despite these being one of the main target groups [59]. In the Lao People's Democratic Republic [49], the project should have focused more on small ruminants (poultry and goats), because not all beneficiaries could afford cattle or buffaloes.

71. **The lack of access to land may lead to the exclusion of vulnerable groups, and in particular women [5, 09, 12, 42].** In Jordan, land ownership was a prerequisite for being eligible for soil and water conservation project subsidies. However, most of the poor (under US$2 per day) were not landowners. The project was therefore inherently unsuitable for reaching the poor and, in particular, women and youth, who were supposed to be specifically targeted [12]. In Ethiopia, affordable irrigation technologies benefitted people who owned land, thus leaving out landless people (particularly women) and even potentially creating conflicts with those groups [9]. In Cameroon, the production area increased slightly; however, the extension of crops (irrigated rice and onion) was constrained by access to land, a limitation that affected especially women and young people [5].

72. **Innovations targeted at indigenous communities must be tailored to the context [19, 47, 49].** In India, improved *jhum* (shifting culture) farming was relevant, as 86 per cent of the total population were tribal and poverty was prevalent among those households which were dependent on *jhum* and facing increasing marginalization because of continuous decline in *jhum* yields [47]. In the Lao People's Democratic Republic, the trainings and technologies geared towards cattle and pigs were not tailored to the diversity of the geographic areas or to the social contexts of the various ethnic minorities, who would have preferred an emphasis on goats and poultry. Although women and ethnic minorities were identified for training, language barriers and the limited follow-up constrained the internalization and uptake of new practices; the benefits accrued largely to better-off farmers and those with prior livestock experience. Although the evaluation reports do not address the question of opportunity cost to the poor (of taking part in trainings and other events), it can be a significant factor in limiting the attractiveness of innovative technology to poor people.

73. **Self-targeting occasionally resulted in the exclusion of the intended beneficiaries [43, 45, 49].** In Cambodia, livelihood income groups did not always include the poorest families, contrary to what was intended. For example, certain criteria, such as "willingness to use modern agriculture technologies" or "possession of some land" (thus being active farmers), excluded de facto the poorest individuals (including the landless) [43]. In the Democratic Republic of the Congo, the self-targeting did not ensure the inclusion of particularly vulnerable groups [45].

B. Partnerships

74. Partnerships are particularly important in three different contexts. First, where research is needed to adapt a variety to suit local conditions, or to develop a variety to tackle a local problem such as salinization or disease. Second, where it is necessary to establish a process to produce quality seeds. Third, for marketing or processing for sale.

75. **Research partnerships mainly supported the introduction of new or improved crops [1, 4, 5, 7, 16, 19, 24, 33, 35, 45, 46, 48] and seed production [35, 45].** The partners most frequently identified were national or governmental research institutes, which would be in charge of developing new crop varieties [5, 7, 16, 19, 35, 45, 48, 54]. In Mozambique [16], improved cassava varieties were introduced in collaboration with the Mozambique Institute for Agricultural Research. Similarly, in the Democratic Republic of the Congo [45], the National Institute for Agricultural Studies and Research (INERA) provided the initial batch of improved crop varieties and healthy cassava cuttings. However, the weak capacities of the INERA provincial branches, combined with late involvement in the project and other factors, affected the quality and quantity of the seeds provided. In Viet Nam [24], IFAD partnered with Can Tho University to develop salt-tolerant rice varieties, in collaboration with agricultural development offices at the district and provincial level.

76. **In a number of cases, partnerships involved international research institutes, such as the Consultative Group for International Agricultural Research (CGIAR) research centres, working with national partners [1, 4, 15, 19, 33].** In Nigeria [19], IFAD developed a successful partnership with the International Institute of Tropical Agriculture and the Nigerian National Root Crops, developing higher-yielding and disease-resistant varieties of cassava. In Bangladesh [1], the International Rice Research Institute (IRRI) received two grants supporting the introduction of alternate wetting and drying (AWD) for reduced arsenic contamination and climate-resilient rice varieties. The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) was involved both in Nigeria [19], for the development of new technologies for dryland agriculture, and in Mali [15], where it provided adapted varieties of sweet sorghum and improved jatropha seeds. In India [33], a partnership with ICRISAT was established to promote the introduction of new crop types. The partnership with ICRISAT and similar organizations did not evolve into a long-term arrangement and was limited to project implementation.

77. **Private companies supported, in particular, cash crops and product processing [7, 15, 23, 25, 35, 48].** In Mali [15], improved jathropa and adapted varieties of sorghum were introduced to feed biofuel production, with the aim of increasing production and farmers' incomes. The cultivation was supported by a partnership with Mali Biocarburant, a biodiesel producer. Similarly, in Uganda [23], the production of oil palm as a cash crop was supported by the private sector for oil palm, considered by IFAD its second most important partner in the country. Oil palm plantations were also introduced in the Democratic Republic of Congo [7], through a tripartite agreement between IFAD's Kinshasa Food Supply Centre Support Programme, village communities and the private company Huilerie – Plantations – Élevage du Kwilu. The involvement of private actors in the Lao

People's Democratic Republic [48] proved to be key in the promotion of cash crops, such as coffee and asparagus, which in turn contributed to increasing farmers' incomes.

78. In Zambia, the adoption of new and improved animal husbandry techniques, as well as of a new beef processing system [25], was enabled by a public-private partnership. Similarly, improvements to the dairy farming system were introduced in Sri Lanka [35] through a public-private partnership with private sector companies and governmental departments. Private and state-owned enterprises provided chilling technologies and cofinanced the construction of processing and collection centres for agricultural and dairy products, which enhanced linkages between farmers and private firms that were interested in entering rural areas to supply the urban demand for dairy products.

Box 2
Partnership with WFP in Rwanda [57]

During the second phase of the Support Project for the Strategic Plan for the Transformation of Agriculture (PAPSTA), marketing support activities were put in place to support innovations in the livestock and agricultural intensification fields. These included a partnership with WFP within the scope of the Purchase for Progress (P4P) framework, allowing rice and maize cooperatives to supply WFP with their surplus production. A second partnership with WFP was established to support soil conservation activities (e.g. digging and maintenance of the anti-erosion ditches), rewarded with food supplies within the Food for Work programme. This activity fostered the involvement of the poorest and often landless households, which could not benefit from the livestock distribution scheme.

Grants

79. Seventeen of the evaluations reviewed for this synthesis reported contributions, from grant-funded activities, towards technical innovation. Some reporting is inconsistent because regional grants often cover several countries, and it is not always possible to identify benefits to any one country in particular because the grants do not link to a specific loan project. Although evaluation reports do not treat grants in a consistent and detailed way, the diversity of ways in which grants make a valuable contribution to technical innovation can be seen. In particular, seven aspects can be identified.

80. **Direct technical development of a potential innovation [12, 14].** In Jordan [12], screening of a large number of forage crops was carried out by the National Centre for Agricultural Research and Extension under a grant to the International Center for Biosaline Agriculture. A number of salt-tolerant species and cultivars were selected, although the evaluation criticized weak linkages with the loan projects. Similarly, in Madagascar [14], high-yielding rice varieties were developed through a grant to IRRI.

81. **Participatory and pilot initiatives to develop new systems and enterprises [17].** In Nepal [17], a grant supported pilot initiatives to develop new systems. The ICRISAT grant (2001-2008) promoted the Farmer Participatory Improvement of Grain Legumes in Rainfed Asi (ICRISAT, 2001-2008). Also, within the scope of the Debt Sustainability Framework, a second grant of US$199,992 was allocated to the Dutch NGO SNV Netherlands Development Organisation for the implementation of the High Value Agriculture – Inclusive Business Pilot Project. The pilot focused especially on organic apple production, as well as on vegetable seeds and *chiuri*.

82. **Dissemination and South-South collaboration [14, 17].** In Madagascar [14], a grant to the Improved Agricultural Water Management in Eastern and Southern Africa Project, co-implemented by ICRISAT allowed for the system of rice improvement (SRI) to be further promoted by farmers in other countries (Rwanda and Burundi). Similarly, in Nepal [17], a grant supported the development and

transfer of technologies for smallholder bamboo and rattan producers from Asia to Africa (INBAR/IDRC, 1996-2000).

83. **Value chain development [7, 15, 19].** Grants were used to support value chains across Africa. In Nigeria [19], a grant identified new uses and marketing options beyond the national market to increase competitiveness of the cassava sector in Nigeria. Similarly, in the Democratic Republic of the Congo [7], a grant was jointly implemented by Africa Rice and INERA to strengthen rice value chains in West and Central Africa. Biofuel chains for the poorest were developed in Mali [15] through a specific grant, aimed at linking the poor to world markets.

84. **Grant cofinancing [59].** In Viet Nam [59], the Pro-Poor Partnerships for Agroforestry Development Project (3PAD) was the first project to have mobilized grant cofinancing from the Global Environment Facillity (GEF). The GEF grant implementation was fully integrated within 3PAD. The GEF resources primarily financed technical assistance, training, studies and services in order to supplement the planned 3PAD activities. It financed innovative environmental pilots, community-based forest management and biodiversity conservation planning, environmental training for the staff of the project management unit (PMU), technical support on environmental aspects of the project (including environmental monitoring), as well as some PMU expenses for operational travel.

85. **Knowledge management and dissemination [4, 6, 17].** In Nepal, two grants were awarded [17] to CGIAR centers and other research institutes. IRRI and the International Maize and Wheat Improvement Center developed the Multistakeholder Programme To Accelerate Technology Adoption to Improve Rural Livelihoods in the Rainfed Gangetic Plains, while ICRISAT fostered the Programme for Harnessing the True Potential of Legumes: Economic and Knowledge Empowerment of Poor Farmers in Rainfed Areas in Asia. Similarly, in Cambodia [4], there are examples of grants reported as facilitating knowledge management and contributing to innovations and improved effectiveness in investment projects. In China [6], the Regional Programme for Rural Development Training (PROCASUR) strengthened knowledge on innovative solutions using the learning routes methodology in Asia and the Pacific.

86. **Energy efficiency [8, 41].** Climate-smart practices, such as photovoltaic energy for pumping, biogas and solar dryers have been promoted in the newlands of Egypt [8] through an Adaptation for Smallholder Agriculture Programme grant. Similarly, in Brazil [41], an IFAD grant for US$500,000 was used to promote clean energies.

Key points

- Most innovations are not specifically targeted, although there are significant examples of innovations being directed to poorer farmers and communities and to women.
- While some innovations are clearly more suitable for better-off farmers (particularly those requiring access to land), overall, innovations are geared towards the "average" (neither very poor nor better-off) farming household. Research partnerships (with national and international research centres) mainly supported the introduction of new or improved crops. Partnerships with the CGIAR can catalyse important innovations; however, often, the partnership is confined to the project duration and does not evolve into long-term partnerships.
- Partnerships with the private sector focus on the introduction of cash crops and product processing.
- One third of the evaluations reviewed refer to grant-funded activities towards technical innovation. Grants play an important role in supporting technical innovations and were used to deliver a diverse set of activities for technical development, piloting, dissemination and knowledge management. IFAD processes are rarely identified as significant contributory factors to innovation. The importance of how IFAD supports innovations is neglected in most evaluations. Only 21 evaluations commented on the importance of IFAD processes, and of these, the majority (15) identified complementary grants as the critical feature. Active policy dialogue and technical support during supervisions were both mentioned, but only in a few instances. The contributions that can be drawn from wider initiatives, such as fostering partnership working and promoting lesson-learning and knowledge management, is currently a neglected area of investigation.

C. Effectiveness of innovations

87. This chapter presents the main findings from the analysis of our sample. Under effectiveness, an analysis was provided of the evidence according to the technical interventions identified, with a focus on those regarding which the most evidence was found. Referring to the criterion of effectiveness, positive and negative patterns were searched for, as well as underlying factors influencing why certain results were achieved or not.

88. There is considerable overlap of innovations per country. Most projects promote multiple innovations, and only a limited number focus on one or two innovations. Slightly over half of all projects and country evaluations identify between 6 and 10 innovations and three CSPEs each identified more than 15 technical innovations. Multiple innovations bring synergies across the technical innovations, address major elements of farming systems, and reduce portfolio risk.

89. **Most innovations occur in packages.** Innovations involving crop management and crop types occur together in 51 per cent of all of the evaluations, and as either one or the other in a further 22 per cent. Innovations involving livestock are typically accompanied by innovations on crops and land management. Twenty-one of the 32 evaluations with livestock innovations also feature innovations with crop management, and of the 11, 7 were associated with crop type innovations.

90. The following section summarizes the innovations highlighted with positive findings in the evaluations, identified according to technical intervention. It is divided into two parts. First, the most frequently occurring technologies are discussed, namely crop types (81 innovations), livestock (65 innovations) and crop management (64 innovations). As crop management and crop types are interlinked, they are presented in sequenced order. In this part, dissemination, input supply, credit, infrastructure, private sector and value chain context for the three types are explored. The second part describes the less frequently occurring typologies of seeds, post-harvest and processing, land management, fertilizers and chemicals,

water and energy. The section ends with a brief overview of three infrequently occurring classes of innovation for fisheries, forestry and agricultural tools.

91. Table 3 summarizes the key features found in the sample concerning the extent to which the innovation has brought about more complex technical change and the demands on new knowledge for adopters.

Table 3
Share of innovations promoting high tech or new knowledge

Innovation type	*High-tech innovations*	*Innovations introducing new knowledge*	*Number of innovations*
Crop types	0%	36%	81
Livestock	25%	57%	65
Crop management	33%	69%	64
Post-harvest/processing	49%	79%	39
Land management practices	3%	42%	33
Fertilizers/chemicals	21%	61%	28
Energy	77%	62%	26
Water	48%	61%	23
Fisheries	68%	79%	19
Seeds	14%	79%	14
Other	20%	70%	10
Forestry	25%	75%	8
Agricultural tools	50%	50%	6
Grand total	28%	59%	416

Source: IOE.

92. For many interventions, the documentation was not sufficiently clear to enable categorizing technical complexity and knowledge requirements in detail. However, the observations do highlight several strong trends:

- With the exceptions of fisheries innovations (which are relatively specialized), energy and a small number of agricultural tools, most innovations are found to be of low technical complexity, which indicates that farmers are not being offered risky changes to their farming practices.
- "Low-input, low-tech" is often a factor in successful uptake. The sample included both positive and negative examples of technical innovation uptake. Some common denominators for positive uptake included being low-cost, low-input, and low-tech to implement, as well as appropriate extension and enabling factors such as access to water and land.
- Most innovations in all categories except crop types and land management require acquisition of new knowledge and skills.

93. These findings are discussed in the sections below.

Crop types

94. "Crop types" was the category of intervention with the greatest number of innovations. In total, 81 innovations were found in 30 countries, across IFAD's five geographical regions. The majority of innovations were related to the introduction of new or improved varieties of locally grown crops (36). Additionally, 14 innovations referred specifically to the introduction of new or improved varieties of rice (both rice-focused and mixed crop interventions). In 31 instances, the

innovations were related to crop diversification, as in the introduction of crops was new to the local context.

95. The new or improved local varieties included: roots, bulbs and tubers; tree crops; field crops; fodder crops; biofuels and high-value crops and vegetables. For both new and improved locally grown varieties, as well as the rice-focused interventions, the characteristics of the introduced technologies were the following: culinary or physical characteristics (e.g. fragrance), field performance or production characteristics (e.g. high-yielding or short duration), abiotic stress tolerance or climate-smart varieties, and biotic stress tolerance.

96. All introductions of new crop varieties, including rice, entailed incremental enhancements to the productivity of locally grown crops as the type of change that was to be engendered in the production systems.

97. For the innovations introduced with the aim of diversifying crop production, the range of crop types introduced included: vegetable species, cash crops, field crops, roots and tubers and various perennials. All introductions of new crop types constituted transformational changes, in that they provided new income streams to farmers, often diversifying farming systems and incorporating high-value cash crops.

98. **There was little targeting of crop type innovations**. Approximately one in three innovative crop types were specifically targeted to households. Among the productivity-enhancing innovations, 16 per cent were directed towards poorer farmers and 8 per cent towards the better-off. For transformative change involving diversification of farming enterprises, 22 per cent were targeted at poorer farmers and 19 per cent at the better-off. Change for the better-off tended to emphasize diversification of production rather than improving varieties. All examples of innovation with crop types were assessed as requiring low technical change; however, four out of every five transformative innovations required farmers to gain new knowledge. Productivity-enhancing change was overwhelmingly seen to require little new knowledge for cultivation; however, this does not imply that farmers would necessarily be able to achieve the full potential of higher yields or better marketing without additional support.

99. **Positive outcomes were reported in 16 cases [1, 4, 5, 7, 8, 10, 11, 12, 16, 19, 23, 39, 46, 47, 54, 59], although some productivity targets were not achieved [22, 8].** In Cameroon, the introduction of short-duration, high-yielding cassava and onions (as well as rice) was considered to be effective [5]. In Ghana, 96,413 farmers (thus exceeding the target by more than 50 per cent) received improved planting materials for high-yielding and disease-resistant cassava, yam, cocoyam and sweet potato. The uptake of these varieties was described as massive, with large increases in yields and boosts to production and productivity [11]. In Mozambique [38], climate-smart cassava varieties contributed to expanding cassava production and increasing productivity [16]. In Egypt, a shift was accomplished, from the cultivation of 3 or 4 cereal and fodder crops to over 20 field crops, vegetables and fruits. The diversification led to increased productivity levels, which in turn contributed to a notable influx of new residents into the area [46], which was part of the overall project goal. In India, Napier grass production was adopted beyond the original intended beneficiary group, as it was important in reducing the drudgery of women as well as in boosting milk production and household income [47].

100. However, in the United Republic of Tanzania, achievements were below target with regard to the adoption of improved seeds for maize, rice and beans (lower than 85 per cent) as well as to the corresponding productivity gains [22].

101. **Cash crops feature in certain innovations [13, 20, 23, 48, 59].** In Kenya, the projects consciously promoted cash crops (e.g. tissue culture bananas, productive pineapple) and cash-yielding animal products (e.g. improved dairy goat) [13].

However, in the case of cash crop development in Rwanda, small landholders were left vulnerable until coffee trees and tea bushes came into production [20].

102. **Farmer-to-farmer approaches was the most prominent mechanism for disseminating technologies.** Different farmer-to-farmer approaches were promoted in a number of projects [11, 21, 4, 35, 42]. In Ghana [11], technology transfer was promoted through farmers' field fora (an upgraded version of the FFS concept) and helped generate substantial yield increases for disease-resistant roots and tubers [11]. In Cambodia, emphasis was placed on group formation, establishing farmer systems improvement (FSI) groups and other farmer-to-farmer approaches. While this method did spread within individual projects [42] overall, weaknesses in the training and extension approach led to the rate of adoption of the innovation being lower than expected. In Sri Lanka [35] the FFS approach was used to expose smallholder farmers to new techniques in onion cultivation practices and to new crop varieties, such as turmeric, ginger, groundnuts and fruit trees (e.g. mango, papaya). The FFS approach was highlighted as an enabling factor in the promotion of the technical innovations. However, it was also critiqued for running the risk of delaying the onset of results.

103. **Use of national or local extension bureaus was found beneficial; however, resource constraints and implementation arrangements affected the relationship [6, 36, 21, 54].** In China, partnerships with local agricultural bureaus proved to be highly effective instruments for the introduction and dissemination of new products and technologies, often by means of demonstration plots [6]. In Azerbaijan, responsibility for agricultural extension was outsourced to the Guba Regional Agricultural Research Centre (GRASC), a well-staffed but underresourced research and development station of the Ministry of Agriculture [36]. In Morocco, the partnership with the National Institute for Agricultural Research (NIRA) on activities to support the provincial agricultural Departments' technical service in setting up trial crops was challenging. Difficulties were linked to a lack of control over financial resources by NIRA and ensuring the timely allocation of funds [54].

104. **Infrastructure – both irrigation and roads – was a crucial enabling factor for introducing technical innovations [23, 43, 58, 54, 48].** Gains in agricultural productivity were driven by the adoption of improved rice varieties and an increased use of fertilizer, irrigation and cultural practices. The construction of canals for supplementary irrigation during the wet season in Cambodia encouraged farmers to adopt improved (albeit more capital-intensive) techniques and thereby boosted productivity further [43]. In Viet Nam [58], with project support, the newly paved or retrofitted village roads made a significant contribution to improving market access. This, along with other newly built small-scale infrastructure, such as improved irrigation, enabled famers to grow higher-value products including seasonal vegetables, soybean and new livestock breeds. In Lao People's Democratic Republic [48], better access roads for the coffee (cash crop) produced reduced the transaction costs for commercialization and facilitated access to markets.

105. **Value chains and public-private partnerships play a distinct role in disseminating technologies [23, 48, 21].** In Uganda, the introduction of oil palm as a cash crop was the first successful example of a major public-private partnership (PPP) in its agricultural sector. Besides introducing a new cash crop to the country, the project's operational model was assessed as a pro-poor innovation because of its built-in mechanism of protecting farmers' interests and supporting an equitable relationship between the smallholders and private companies. In that sense, the PPP was an essential element to support the technical innovation. The PPP approach involved central and local governments, private-sector partners and farmers' organizations. It was a comprehensive approach, addressing also infrastructure constraints (e.g. ferry connections), and it was based on contracts. While time-consuming and challenging, once established, the PPPs provided a solid

foundation for integration and development [23]. In Lao People's Democratic Republic, the involvement of the private sector in the promotion of cash crops had a direct beneficial effect on income. Some challenges were that crop types were introduced through direct contract farming with a PPP approach, in which private-sector companies provided inputs such as seeds, fertilizers, extension services and outlets to farmers. This meant that farmers remained dependent on traders for market information, input supply and sales of produce, to the extent that they had to accept the prices given and, in several cases, were forced to pay double the market price for inputs provided on credit through the farming contract system [48].

106. **Understanding markets and buyers is necessary to ensure that production can be marketed at a fair price [16, 48, 17].** In Mozambique, climate-smart cassava varieties increased the production of cassava. However, as the production increased at a much faster pace than the market could absorb, the price of cassava decreased. While the design had identified several market opportunities for the cassava-based products (e.g. chips for animal feed, ethanol, flour supply to mobile processing units linked to the national brewery industry), the farmers were forced to sell their products to a Dutch company that enjoyed a monopoly and could thus pay a low price [16].

Crop management

107. As with the innovations applying to crop types, innovations in crop management were not introduced in isolation but rather were linked to crop types, seeds, fertilizers and water. Crop management innovations were introduced through 64 interventions in 28 countries, across five regions. The highest number of innovations was related to a diverse range of improved crop cultivation techniques. Often, there were no details on the crops to which they were applied; however, it was known that these regarded mainly vegetables, fruit trees and forage crops (27), followed by rice cultivation techniques (14), mostly referring to SRI. As these innovations were grouped with one another, results for the crop management aspect are less frequently reported on compared to other associated innovations, such as crop type and livestock. Also, input supply, credit and infrastructure were not prominent features of the issues raised and are therefore not covered in this section.

108. **All innovative crop production methods were aimed at incrementing productivity.** Fifty-eight per cent of innovations dealing with crop management were not targeted. A number of interesting examples of higher-technology innovations, such as greenhouse cultivation, being targeted towards better-off families do exist; however, there are few observations that can justify identifying a clear trend. Improvements to crop management mostly have a relatively high requirement for new knowledge, even though two thirds are changes of low technical complexity.

109. *Improved crop cultivation techniques* were introduced in 21 countries, across five regions. The range of crops involved included vegetables, roots and tubers, maize and fodder crops. Specific management practices included mulching, seedling nurseries, crop establishment and spacing, timing of planting, and harvesting.

110. Results on the benefits of cultivation were documented only in a few cases [4, 8 and 15]. For example, improved cassava production methods in Cambodia [4] were adopted by approximately 40 per cent of farmers and increasing yields and incomes, to which this activity contributed, were noted. In Egypt [8], only 10 per cent of project beneficiaries took up new crop cultivation techniques. In Mali [15], 712 ha of *bourgou* (hippo grass) plains were regenerated and 1,628 ha were restarted.

111. *Improved rice cultivation techniques* were introduced through 14 interventions. The focus was mainly on SRI (11 projects) and included: transplanting of seedlings,

improved variety use, use of compost and soil nutrient management. Other rice production techniques promoted were weed management and crop establishment.

112. **The results of the improved rice cultivation were mostly positive** [33, 42, 47, 57, 42]: several reports described SRI as a successful innovation that was gaining popularity among farmers (33, 42, 47, 57), leading to notable adoption levels and being a driver of increased productivity and income [33]. In Cambodia [42], SRI was among the technologies with the most successful adoption rates. However, other reports indicated mixed adoption rates for different elements of SRI [4, Cambodia], or low levels of adoption altogether [48], as well as disadoption in one case [14]. The main constraint on implementing transplanting in lieu of broadcasting was noted to be the heavy workload this method required. Furthermore, in one instance, the widely spaced planting of single seedlings was found to be inappropriate to local conditions where snails and insects damaged many plants, resulting in empty spots and lower yield.

113. **South-South cooperation was effective for knowledge transfer in the few cases it was reported [20, 52].** In Rwanda, training and study tours were organized to increase knowledge on SRI for project stakeholders and beneficiaries on SRI technology imported from Madagascar [20]. In Mauritania, exchange visits with households living in adjacent Morocco fostered the introduction of new agricultural techniques into the market gardening practices used in oases. Impacts were observed on women's attitudes and social position, culinary recipes based on locally available products, market gardening, income-generating activities and crafts), as well as on the diversification of meals and on the improvement in the diet of households and children in particular [52].

114. **Crop diversification and off-season varieties were taken up in settings where value addition and better linkages to markets were ensured [1, 17, 35, 40 and 47].** In Bangladesh [1], new practices for more intensive farming on small plots were enabled by linking them to market demand for off-season vegetables and a wider market variety. In Bhutan [40], crop diversification, particularly for vegetables (off-season) contributed to increased productivity. Specifically, off-season vegetables, early chilli cultivation, upland paddy, intercropping with citrus crops and the cultivation of organic buckwheat contributed to increasing productivity from the same or smaller land area.

Key points

- IFAD's innovations are stimulating change from the cultivation of traditional staples to that of cash crops, roots and tubers, vegetables, beverage crops and fruits. The introduction of new crops to diversify production is a transformative change, which entails higher risk for growers. These innovations are found in over 30 examples across 17 countries.
- Diversification can benefit the family diet; however, more often, the aim is for cash crops to generate new income. In these cases, the links to processing and markets becomes more critical.
- A number of examples have shown how IFAD has been able to support farmers' interests and achieve an equitable relationship between farmers and buyers; however, in other instances, farmers have been at a disadvantage. Being able to organize farmers and provide access to market information is a vital element of good design.
- Innovations in crop types and crop management were directed broadly towards all farmers. Most innovations aimed at increasing productivity. Most were low-tech. Both classes of farmers found farmer-to-farmer dissemination to be effective.
- Improved crop varieties and some new crop types were effectively targeted at poorer households; neither types of innovation were technically complex.

Livestock

115. Innovations related to livestock were introduced through 65 interventions in 30 countries, across IFAD's five geographical regions. The majority of innovations were related to livestock breeding (20) which was introduced in 15 countries across four regions. Animal health and nutrition (13) and small animal husbandry (7) were other prominent innovations that were implemented in 13 countries across five regions. These innovations focused on vaccinations and deworming, multinutrient and mineral blocks, and other animal health and cow-rearing practices. Under small husbandry, the innovations included improved management of small ruminants and improved production methods (piggery, goat rearing, ducks). All but one of the technologies introduced fall under the cluster of productivity enhancement.

116. **Most livestock innovations were targeted, with 15 per cent being aimed towards poorer farmers and 9 per cent towards women.** However, the main targeting (34 per cent) was towards better-off families. Where information was reported, two thirds of the innovations involved a low technical scale of change, such as improved feeding or animal housing; only one third was more complex, mainly dealing with animal health interventions or breeding (in particular, the use of artificial insemination). Many innovations dealt with changes in productivity and required little in the way of new knowledge; however, more than half did involve farmers in the acquisition of new knowledge. Transformative change more often involved higher technologies, in which a positive result is more sensitive to factors such as dosage or the timing of a treatment.

117. **The introduction of new breeds and artificial insemination, both forms of higher technology, provides more negative examples than positive ones [13, 20, 10, 22, 54, 59, 37, 36].** Kenya and Rwanda stand out as positive examples. In Kenya [13], the introduction of the German Alpine and Toggenburg dairy goat breeds made a significant difference to the previous low levels of productivity. In Rwanda [20], the introduction of exotic breeds of dairy cows and artificial insemination increased milk production seven times, since the year 2000.

118. However, in The Gambia, *kafos* (local village groups) supplied their own female animals as part of their contribution, while the project supplied improved male breeds. Still, many farmers reported issues. Some had sold one or more of the rams provided by the project due to aggression and lack of separation of the males

from females. This meant that controlled breeding was still not being realized. Introduction of improved cockerels also took place; however, the complete replacement of local varieties was rarely achieved [10]. In the United Republic of Tanzania, the achievements did not meet the targets, even though the inputs were subsidized under a voucher scheme [22]. In Viet Nam, new animal breeds were too expensive for poor households [59]. In Bangladesh [37], the adoption levels were low.

119. **The results relating to animal health and nutrition are sparse; however, the results relating to vaccination and deworming are generally positive [4, 10, 12, 37, 49, 54].** In the Lao People's Democratic Republic [49], the project complemented the government's own initiative to promote vaccinations. In Cambodia [4], vaccination had the highest adoption rate among a number of innovations. In Bangladesh [37], the project introduced the deworming of cattle with a 28 per cent adoption rate, against 16 per cent in the control group. Deworming was one of several higher-technology innovations introduced and was adopted together with artificial insemination, while other technologies were not. The introduction of multinutrient and mineral blocks in The Gambia [10] improved knowledge and practices; however, adoption was slow.

120. **Training local people was an effective way to deliver decentralized animal health services [20, 43, 46, 49, 58].** In Cambodia [43], using village animal health workers (VAHWs) was a successful approach to the privatization of extension services in the villages, although the target number of extension events was not achieved. The most frequent services were treatments administered to pigs, then cattle and buffaloes, followed by vaccination of cattle and pigs; important gains in productivity were made (more than 50 per cent, for 26,500 farmers). The VAHWs were located where their services were required; this allowed them to deliver services effectively and efficiently. The advantage of their proximity to service users was that access to knowledge was local, the feedback loop was short, and response was quick. In addition, the use of local people as agricultural service providers built local capacity, grew local leadership, localized agricultural extension services and promoted private sector development. The establishment of VAHWs was particularly successful because they worked on a fee-for-service basis. In Viet Nam, the Department of Animal Health trained one VAHW for each project village. Access to animal treatments services increased by 562 per cent.

121. **Cooperatives and farmer federations were established and used to channel innovations, with mostly positive results [20, 21, 33, 35, 41, 54].** In Senegal [21], the gathering of pastoralists into pastoral units was used as a channel for introducing livestock management innovations. The pastoral units achieved autonomy and provided essential services to members, defending their interests and promoting the participation of women and youth in community decisions and activities. In Morocco, the grassroots development associations created for income-generating activities did not work as a group, and were often characterized by actions and strategies engaged in for the benefit of individuals [54].

122. **The importance of training and provision of veterinary care was a frequent issue [13, 25, 49, 37, 57, 20].** In Kenya [13], it was acknowledged that the improved genetic stock required proper management if it was to demonstrate its potential. Therefore, all projects invested in knowledge transfer, awareness-building, and training and coaching of farmers (men and women alike). In Rwanda [57], veterinary services were provided for high-quality breed livestock (organization of veterinary care through para-veterinarians).

123. **Innovative distribution schemes had mixed results [57, 50].** In Rwanda [57], a project distributed high-quality breed livestock using a revolving credit-in-kind system, known as pass on the gift (POG). This system was organized through

community groups and producers' associations, following specific eligibility criteria for selecting beneficiaries based on their physical and financial capacity to establish required facilities (such as forage and cattle sheds). POG schemes for livestock (mainly cows for landholders owning more than 0.5 ha and goats for landholders owning less than 0.5 ha) aimed to establish a solidarity chain in the community. The economic situation of the households that had received a cow significantly improved. The construction of milk collection centres and the provision of support to cooperatives in marketing milk greatly improved the cash incomes of the participating households (noting that some markets were more reliable than others). The households having plots of land that were too small to feed a cow (under 0.5 ha) received small livestock (goats, pigs, rabbits). The latter group's cash income also improved, although not to the same degree as that of the former group. The POG system worked well and is now a well-established practice in Rwanda.

124. In Lesotho [50], a similar system did not work. While the principle was sound, there were problems with the sequencing of training and distribution, and with record keeping by farmers, which led to low numbers of additional farmers who would benefit from improved livestock production as a result of the scheme.

125. **In some instances, livestock innovations were enabled by essential provisions of credit. [37, 58, 35, 54].** In Bangladesh [37], microcredits focused on the livestock and poultry sector and led to the introduction of vaccinations, deworming and mini-hatcheries. The credit-plus-training approach adopted gave the targeted poor access not only to loan funds, but also to skill-development training, thereby improving their knowledge, providing them with exposure to improved production technologies and practices and new information, and linking them with service providers and markets. In Morocco [54], income-generating activities were created through microcredit and included beekeeping and sheep and goat production, as well as the use of aromatic and medicinal plants. The best results were obtained with livestock production activities (goats and sheep). In Sri Lanka [35], dairy farming innovations were enabled by way of: (i) innovative self-finance investments; (ii) cofinancing by private firms; and (iii) revolving beneficiary funds. The establishment of revolving funds by beneficiaries was a crucial factor in sustaining dairy societies. However, subsidized credit was assessed to be inefficient, as it led to credit rationing for profitable pursuits (notably, dairy farming).

126. **Infrastructure was also an enabling factor for livestock technologies [50, 20, 35, 36].** In Rwanda [20], the distribution of cows was complemented by support for building a stable and planting of fodder grasses and trees. In Sri Lanka [35], dairy farming innovations were made possible through the construction of processing and collection centres for dairy produce, cofinanced by the private sector. In Azerbaijan [36], irrigation infrastructure, coupled with cattle genetic improvement, beekeeping and agricultural extension, led to significant production benefits for small farmers and displayed strong potential to meet the need to improve the food security and income of small farmers.

127. **Linkages with private companies fostered the value chain development of processing and marketing [35, 25, 49].** The dairy societies [35] empowered farmers to undertake negotiations with the private sector by increasing the confidence of their members, increasing their bargaining position in relation to buying price and conditions (i.e. pricing based on milk protein and fat content). The private sector cofinanced equipment for and the construction of processing and collection centres for agricultural and dairy produce. Many private sector operators in Zambia showed genuine interest in working with small farmers, and the government had manifested its commitment to bringing on board all players in the agricultural sector, including the private sector and civil society. However, the enabling policy environment for PPPs was not fully supportive; there was some

distrust and a lack of effective mechanisms to build good working relationships between the value chain actors of the private and the public sector [25].

Key points

- In contrast to crop types and crop management, livestock innovations were more clearly targeted; many of those directed towards the better-off involved higher technical complexity.
- For livestock, the enabling environment was particularly important in respect of the use of cooperatives or other farmer organizations, the provision of credit, infrastructure and the empowerment of local people through training to provide local health services.
- Livestock interventions need comprehensive packages of technical support. The large number of innovations linked to livestock indicates the importance of this subsector. However, the evaluations also illustrate the challenges faced.
- The most common interventions aimed towards introducing improved breeds and breeding. Few succeeded, being unable to take hold for a variety of reasons including cost and procurement problems. The thriving experience in Rwanda (see case study in annex II) is an exception.
- Interventions on animal health and productivity have been more successful. Necessary factors are careful targeting of participating farmers, working through cooperatives and farmer federations, establishing links to veterinary support, calibrating the intensity of the intervention to effect real genetic change in the population and introducing complementary interventions in nutrition, infrastructure and credit. The VAWHs in Cambodia illustrate the benefits of establishing a localized service created by training local people.
- Vaccination programmes were often unsustainable [49]. Problems arise from a lack of linkages with public animal health systems and livestock providers. Improving breeds at scale may be difficult because of the number of males needed, a problem faced in Lesotho [50]. More often, livestock improvements were considered less relevant to poorer households (Viet Nam [58]).
- In the few interventions dealing with milk production, links with the private sector provided opportunities for cofinancing and partnerships. Apart from small stock and enterprises such as beekeeping, transformative livestock investments were often less appropriate for poorer households.
- The issues documented highlighted the importance of investing in enabling factors to facilitate technical change and to ensure that new introductions are appropriate, both culturally and in light of the established diet [33].

128. The following section covers the nine remaining typologies, which were less frequent and less standardized.

Seeds

129. Innovations related to seeds were introduced through 14 interventions in 10 countries, across four regions. The main innovations fall under two clusters: certified/quality seeds (production and use, 8) and seed/tuber multiplication (6).

130. **Seed multiplication constituted a transformational change, as it provided farmers with a new source of income.** Certified/quality seeds were introduced for the following crops: rice, groundnut, cowpea, maize, peanut, mung bean and cassava resistant cultivars. Among the eight innovations identified within this cluster, five were related to the production of certified/quality seeds, which represented a new income stream for the few beneficiaries able to participate, thereby promoting a transformative change. Other three innovations were related to the actual use of certified seeds, which fostered productivity and allowed farmers to sell their products at higher prices. Innovative hydroponic technologies for seed multiplication were introduced for potato, onion, acacia, and hybrid spiny bitter gourd crops.

131. Most examples of improved quality seeds were of low technical complexity and, in a few instances, were targeted towards poorer families. The more innovative seed multiplication techniques, such as hydroponics, were more demanding technically.

132. Adoption levels and outcomes were documented in a limited number of instances. In Bangladesh [38], improved rice seed production was coupled with the Maria model for rice seed preservation, and was employed by 25,534 farmers to store rice seeds. In Mali [15], more than 700 producers were engaged in quality seed production, meeting the local demand. In Sri Lanka [35], eight farmers invested in greenhouses for hydroponics production.

133. However, there were some issues, for example in the Democratic Republic of the Congo [45], where seed recovery (as part of the seed multiplication process) was not effective. This was because of an unreliable supply of seeds and of delays that affected the innovation outcomes. In Pakistan [56], the multiplication of quality seeds was introduced through a contract grower arrangement. However, collection and grading for resupply failed. Most seeds went untraced or were consumed locally.

134. **Partnerships with research institutes were important for availability and quality seed production [7, 39, 21, 35, 19, 15].** Seeds were provided by national research institutes (e.g. the Bangladesh Institute of Nuclear Agriculture), which were highly important in ensuring adoption of the innovation. However, there were some issues, for example in Nigeria [19], where the introduction of certified seeds was constrained by unavailability and by the high cost of inputs.

Post-harvest and processing

135. Post-harvest and processing innovations were introduced through 39 interventions in 22 countries, across five regions. The majority of innovations identified in this field were clustered as improved methods for post-harvest and processing (23) or tools/equipment (14). Two single innovations were identified as improved management and storage (on farm grain/bean storage). Most of the innovations were productivity-enhancing (22), followed by transforming (16). Only one was considered asset-enhancing.

136. **Interventions were knowledge-intensive**, **with four out of five requiring new knowledge and half being considered to involve higher technical change.**

137. Some positive results were reported [10, 14, 20, 22, 25, 48]. For example, in Ghana, cassava processing equipment was slowly starting to yield positive results. In Rwanda, better prices were obtained from quality improvement in the cultivation of tea, improved processing techniques and increased blending and packaging [20]. In Madagascar [14], the importance of introducing improved post-production technologies, in combination with better irrigation systems, were highlighted as a reason for the enhanced rice production.

138. **Post-harvest equipment was introduced on a very limited scale, with subsequent limited effects [5, 7, 40, 54].** In Cameroon [5], the quantity of processing equipment was limited, and the quality was sometimes low. In the Congo, 40 rice huskers were introduced; however, the outputs were weak and their effects were therefore limited [7]. Post-harvest equipment was introduced on a limited scale in Bhutan, with varying rates of success [40]. In Morocco, outputs were more positive; however, the scale was still limited. Two crushing units and six fixed threshers were introduced; these have helped to improve the quality of finished agricultural products, notably olive oil and wheat [54].

139. **Support to value chains was the focus in some cases; however, the results achieved with processing equipment were mixed [21, 54, 41].** In Senegal [21], the combination of training and product processing, and a value-chain approach, led to good results. In Morocco [54], the oil extraction equipment for

walnuts and aromatic and medicinal plants not only improved the quality of agricultural products but also increased the professionalism of farmers. These are important achievements. However, it should be noted that the impact of this machinery and processing equipment did not lead to a substantial increase in beneficiaries' income.

140. **Infrastructure was sometimes built without adequate building specifications and was of low quality [23, 25].** In Uganda, the building in which the maize mill and the coffee huller were supposed to be housed was unsuitable (there were multiple issues, including the absence of any physical separation of raw material inflows from finished products outflows). In Zambia [25], honey cottages, and other infrastructure, were found to be of poor quality.

Land management

141. Nineteen instances of innovative land management practices were identified across 17 countries in five regions, and mostly relate to soil fertility and erosion control, such as gully management, infiltration ditches, forage-based conservation and live fencing. The introduction of technologies related to land management was always associated with crops or livestock. Therefore, cross-cutting issues are covered as part of the analysis of those sections. A large minority of land management interventions brought a need for new knowledge, such as for pasture and grazing management, and nearly one in five were assessed to be geared more towards better-off farmers owing to land ownership requirements.

142. **Few results were reported for soil fertility [7, 8] and erosion control [2, 57].** In Congo, the introduction of the Mukuna velvet bean as a cover plant in the rotation cycle had a beneficial effect on the fertility of savannah soils through the improvement of soil texture through burial, which can help limit pressure on gallery forests (7). In Egypt, incomes increased in part through the use of legumes for soil improvement (other reasons were savings on fertilizers and water, and higher productivity of the new crop varieties) [8]. In Rwanda [57], soil and water conservation technology promoted by PAPSTA included a package of activities: constructing full and half terraces, anti-erosion ditches/cut-off drains and soil bunding. In Bolivia, contour tillage, crest infiltration ditches and gully control complemented traditional soil conservation techniques. However, the goal of establishing an area covered by new techniques on plantation, improvement and soil management practices was only partially achieved [2].

Fertilizers and chemicals

143. This synthesis identified 28 instances of innovative fertilizers and chemicals across 15 countries in five regions. Eight fall under the categorization on fertilizer use efficiency (fertilizer use management tools, introduction of fertilizers – e.g. fodder improvement for cows – and phosphate fertilization of fodder), ten under organic fertilizers (e.g. improved soil fertility) and ten under pest or weed management, including integrated pest management (IPM) and integrated weed management (IWM), such as biological plant protection, biological repellents to animals and palm tree management practices. All of the examples fall under the typology of productivity enhancement. Approximately 21 per cent were more technically advanced; most innovations were low-tech but required a high level of new knowledge.

144. **Innovative techniques to improve fertilizer efficiency were reported from Bangladesh.** In Bangladesh [38], the use of leaf colour charts (LCCs) resulted in a reduction in the quantity of urea applied by approximately 20 per cent, as well as an increase in grain yield by 8 per cent. This was due to optimal application. Four hundred applicator machines were introduced and training was provided to overcome the constraints of manual labour-intensive application.

145. **All innovations regarding organic fertilizers involved composting** and included: (a) introducing new composting techniques such as vermicomposting and

the use of composting and animal manure, and (b) promoting improved compost use. Most composting activities involved provision of training and demonstrations [22, 42, 43, 58].

146. **Use of IPM/IWM has reduced chemical inputs and lowered costs.** IPM/IWM was promoted across different projects [1, 2, 6, 11, 18]. In China [6], the introduction of IPM practices in Ningxia and Shanxi provinces reduced the use of chemicals to a minimum, achieving a reduction in non-point source pollution. In Bangladesh [1], pheromone traps were introduced as part of a package of five low-cost and low-risk technical innovations, as part of a microcredit project. This simple technology was an environmentally friendly and low-cost substitute for insecticide, used to reduce pesticide use in vegetable cultivation. By the end of the project, 461 field demonstrations were organized and 28,000 traps were distributed to the beneficiaries, with approximately 1,435 farmers using this technology. Farmers reported a 50 per cent saving in the costs incurred for insecticides during that time. It was estimated that production increased by 25 per cent. In Mozambique [16], a diamond black moth biological control technology was piloted and showed promising results in terms of diamond black moth reduction.

Water

147. Water-related innovations were introduced through 23 interventions in 12 countries, across five regions. Most of the innovations concerned drip irrigation, followed by water harvesting and small-scale irrigation. All except one were associated with innovations for crop management and crop types. Most of the innovations were productivity-enhancing in nature (13). Seven were transformative, two relate to health and one to assets.

148. There is little evidence of any explicit targeting in these interventions. However, approximately half were relatively high-tech and most involved new knowledge about water harvesting and management of delivery.

149. **Positive results were reported on drip irrigation, water harvesting and small-scale irrigation** [1, 8, 9, 12, 16, 41, 46, 47]. In Egypt [46], a combined use of rural finance and extension to promote drip irrigation for field crops and vegetables (e.g. maize and potatoes) and fruit trees (e.g. oranges) was effective. Substantial efforts went into converting moveable sprinklers to fixed sprinkler and drip systems. By project completion, 15,263.64 ha (65 per cent of the primary project area) had been converted to drip and fixed sprinkler systems. Farmers reported that 90 to 95 per cent of farmers had converted to drip irrigation. The technology was relatively low-cost and materials appeared to be readily available; the farmers saw an immediate advantage and were therefore motivated to use it. In Jordan [12], improved water harvesting techniques (specifically, the modified Vallerani mechanized system[22]) were introduced to demonstrate improved water-harvesting techniques, cropping systems and instruments in microcatchments for high fodder shrubs and fruit tree production. The results of the demonstrated improved water harvesting techniques in Jordan were adopted by the country's Environmental Compensation Unit, initiated and supported by the United Nations Compensation Committee. Higher rates of return for barley were recorded with the improved water harvesting techniques, compared with planting the crop with traditional pits. Less progress was made in integrating results into policy requirements for development and restauration of the Jordanian Badia [12]. In Ethiopia, affordable small-scale irrigation technology focused on manual pumps and spate irrigation, and has resulted in increased production for field crops and vegetables in home gardens [9].

150. In India [47], improved lightweight pitchers for drinking water collection was part of a broader range of drudgery-reduction activities employed to significantly free

[22] The Vallerani mechanized system consists of a special tractor-pulled plough that automatically constructs water harvesting catchments. It is ideally suited for large-scale reclamation work.

up women's time. The effectiveness of the lightweight water pitchers vastly exceeded the original expectations of the project. The project "demonstrated" the technology to just over 1,900 household, eventually finding that it had been adopted by well over 12,000 households.

Energy

151. Innovations that promoted sustainable energy use were introduced through 26 interventions in 13 countries, across five regions.

152. The main innovations fall under four clusters: biogas technology (9), a combination of biogas and renewable energy sources (2), efficient stoves (8) and renewable energy sources (solar/wind) (7). Most of the technologies introduced promoted a transformative change (17), while some technologies were introduced with the aim of reducing firewood use and were thus asset-strengthening (8). In two instances, the technology qualified as drudgery-reducing technology, fostering health improvements among the beneficiaries.

153. Only 26 out of more than 400 innovations dealt with alternative energy, an indication that these are not seen as mainstream interventions in IFAD. Yet, in the context of energy innovations, some visible targeting towards women was evident, especially for energy generation and more efficient stoves. The ESR assessed slightly under 80 per cent of the innovations as being of higher technical complexity.

154. **The use of biogas has the potential to reduce firewood consumption and improve health.** Two thirds of the interventions related to biogas reported positive impacts on NRM, fostering adaptation to climate change, reduction of fossil fuels and environmental conservation [1, 9, 10, 41 and 57]. In Bangladesh [1] for example, the use of biogas units saved approximately 1.5 – 2 tons of fuelwood per year. India [33] represents an exception in terms of diffusion of the innovation; here, the promotion of biogas had a very limited uptake among farmers, who continued to rely on fuelwood as their primary source of energy. This constrained the forest conservation efforts pursued by the project. In Brazil [41], biodigesters[23] were introduced in combination with improved stoves as drudgery-reduction technologies, specifically targeting women. A positive impact on women's health was registered in Rwanda [57], where the use of biodigesters represented a solution to the problem of smoke in kitchens without chimneys, which would form when burning firewood. In Ethiopia, there was a high uptake of biodigesters, with the construction of 21 biogas plants (exceeding the initial target by 700 per cent). However, the functioning of these plants relied on the reuse of animal manure. This limited the involvement of female-headed households, who often did not own a big herd and therefore lacked the manure required [9].

155. While the majority of biogas interventions were introduced at the household level, in two instances [8, 56], biogas technology was introduced in combination with other renewable energy sources, both at the household and at the village level.

156. **The introduction of improved stoves had a positive impact on women and NRM.** The innovation reduced drudgery among women, reduced smoke in the kitchen and fostered better hygiene and living conditions [9, 57]. In the case of Bolivia [2], 56 per cent of the interviewees also reported improved nutrition. The introduction of improved stoves, often coupled with biodigesters (5 instances), had a positive impact on NRM. For example, in Viet Nam [59], the use of improved stoves reduced firewood consumption by 30 per cent. In Ethiopia, energy-saving stoves were coupled with two other technical innovations (solar pumps and home gardening) with the aim of fostering small-scale irrigation. The project introduced 3,581 fuel-efficient stoves, achieving 81 per cent of the initial target, with positive outcomes in terms of climate resilience and drudgery-reduction. The stoves were

[23] The terms "biogas" and "biodigesters" are used interchangeably in the sample of evaluations and are therefore discussed together in this section.

adapted to the local context and made suitable for preparing *injera*, the main staple food in the highlands [9].

157. **The use of renewable energy sources had limited outreach [10, 33 and 7].** Solar pumps in The Gambia [10] reported a slow diffusion and the use of solar energy in India [33] registered low outreach, which affected the environmental impacts of the innovation. In the Democratic Republic of the Congo, solar pumps were neither fully adopted nor maintained, given the high operating costs for the beneficiaries, the required maintenance of photovoltaic panels and the changing of of batteries. In this regard, hand pumps proved to be more suitable to the beneficiaries' needs.

158. A number of other technologies were identified in the areas of fisheries (19), forestry (8) and agricultural tools (6).

159. **Fisheries**. Innovations related to fisheries were implemented through 19 interventions in nine countries, across four geographical regions. The technical innovations identified were clustered into three domains: fish cultivation and aquaculture (12), boat construction (4) and fishing equipment (3). Positive results were reported in four countries.

Box 3
Introduction of innovations in the artisanal fisheries of Mozambique

In Mozambique [16], despite the successful training of fishermen, the adoption of ice production at markets and navigation equipment was constrained by a delay in the establishment of appropriate financial services (e.g. transfers, credits and incentives), which prevented the beneficiaries from accessing the technologies through credit. In particular, the use of ice as a conservation measure was hampered by the lack of financial instruments to support the initial investments in cool storage facilities. The beneficiaries, who traditionally did not use ice as a conservation practice, were initially hesitant and had limited funds to invest. Moreover, ice production and storage facilities were dependant on public electricity grids, which were not widely available in remote areas of the coasts. The project contributed to the construction of a number of grids to supply first sale markets in Zalala, Zambezia [34].

160. **Forestry.** The ESR identified eight examples of innovations related to forestry across five countries in four regions. Three related to agroforestry, two to forest resource harvesting, and two to forest nurseries and tree planting. Three fall within the cluster of transformative change and five within that of asset enhancement. The agroforestry projects covered the following: domestication of new agroforestry species for food security [5]; diversification of agroforestry parks for sustainable exploitation [15]; and sustainable forest protection/intensive mixed agroforestry systems (hedgerows) [59]. Two innovations in Zambia were identified: forest resource harvesting covering non-timber forest products (e.g. mushrooms), and bamboo and rattan production. Examples of forest nurseries and tree planting were identified in Bolivia [2] and Viet Nam [24].

161. **Agricultural tools**. Agricultural tools were introduced through six interventions made in four countries [2, 40, 45, 47], across three regions. Two of the technologies introduced targeted productivity enhancement, while three interventions strengthened the beneficiaries' assets. One tool was specifically introduced to reduce drudgery among women, thereby promoting health improvements. The technologies included both agricultural tools, such as camelid shearing machines, and ergonomically designed tools for drudgery reduction [2, 45, 47, 40].

Innovation typology

162. This review of innovations has highlighted the issues of technical change and knowledge. Table 4 summarizes the nature of the changes evidently brought about by the innovations. Productivity-enhancing innovations outweigh transformational

change by a factor of two to one, and together account for 85 per cent of all the innovations reviewed. Half of both the productivity and transformational changes are associated with low-tech innovations. However, 40 per cent of the transformational change innovations are high-tech, double the proportion of productivity. Changes to farm asset endowment and to family health are associated mainly with more specialized innovations, such as land management, forestry, energy and fisheries. However, these are few in number and their application is specific to their context.

Table 4
Intended results of innovations

Innovation type	*Increase productivity*	*Facilitated transformation*	*Built assets*	*Improve health*	*Total number of innovations*
Crop types	60%	40%	0%	0%	81
Livestock	85%	14%	2%	0%	65
Crop management	86%	5%	9%	0%	64
Post-harvest/processing	56%	41%	3%	0%	39
Land management practices	3%	9%	88%	0%	33
Fertilizers/chemicals	100%	0%	0%	0%	28
Energy	0%	65%	31%	4%	26
Water	57%	30%	4%	9%	23
Fisheries	26%	47%	26%	0%	19
Seeds	29%	71%	0%	0%	14
Other	10%	80%	10%	0%	10
Forestry	0%	38%	63%	0%	8
Agricultural tools	33%	0%	50%	17%	6
Grand total	235	117	60	4	416

Source: IOE.

163. The preponderance of productivity change and low technology is a defining feature of IFAD's portfolio. It confirms a logical and practical approach to widespread incremental change, which tends to be more inclusive and often less environmentally damaging. It is also logical from the perspective of integrated farming systems. Further details are explored in the next chapter.

Key points

- Most innovations are not targeted; however, targeted efforts for women have been made, with the introduction of technologies on energy, water and livestock.
- Most of the technical innovations are in fact low-tech and seek to enhance productivity rather than transform the farms. Most innovations focus on changes to productivity through: (i) introducing new or improved varieties of locally grown crops; (ii) providing a package of improvements dealing with their management, seeds, use of fertilizers and chemicals and often water suppliers; (iii) enhancing livestock health and husbandry. Mostly, these present lower risk for the farmers.
- For the three most common categories (crop type, crop management and livestock), dissemination was fostered to some extent by value chain interventions and links to the private sector. Progress is generally reported as slow, with mixed results. Success has tended to come where there was a package of technical support measures for the enterprise, in addition to training and improved equipment for processing.
- Most innovations require new knowledge and skills, which highlights the importance of accompanying support through partnerships. Technical innovations to support value chains must consider the entire process, from inputs to processing and marketing. Problems would arise when one element was overlooked. In Cambodia [43], crop and livestock production increased, but links to markets were not achieved. In Mozambique [16], cassava production expanded faster than the market could absorb. In Nepal [17], income gains from sales of organic apples and vegetable seeds were at risk of overdependence on a single buyer.

D. Impact of innovation

164. This section examines the evidence of impact arising from technical innovation. The analysis is structured around four aspects of impact: (i) household incomes and assets; (ii) food security and productivity; (iii) NRM and climate change; and (iv) gender and youth. Each section identifies the types of innovation reported as generating impact and gives examples of the more successful projects and countries.[24]

165. The information reported on the nature of the impact varies greatly across projects: some report the results of independent surveys, although most quote the results of trials, demonstration plots or the perceptions of farmers. In some cases, independent data for specific innovations were reported from farm observations. To simplify the analysis and draw these diverse statements into a common basis, impact was coded wherever a positive result was reported – irrespective of the data source – but only where there was a stated or plausible link to the technical innovation. The frequent presence of grouped innovations limited the instances in which a direct link could be established; this is why the number of innovations with a reported impact is much lower than the number of innovations implemented. This does not imply that many innovations have no impact, but rather, simply, that the impact cannot be traced. The categories of household income and assets, food security and productivity, etc. used in table 5 follow conventional areas of impact used by IOE. Examination of the success ratio (the proportion of innovations with a clearly identified positive outcome) highlights those technical areas in which impact has occurred. Table 5 lists the major types of innovation and nature of impact using the IOE categorization.

[24] It should be noted that successful technical innovations sometimes occurred in projects that were not successful overall. Likewise, unsuccessful innovations were registered in otherwise successful projects.

Table 5
Innovation types with the highest number of positive statements for innovation impact across countries

Innovation type	*Household incomes and assets*	*Food security and productivity*	*ENRM and climate change*	*Gender*
	Number of technical innovations with reported impact *(number of countries in parentheses)*			
Crop type	**21** *(14)*	**25** *(18)*		
Crop management	**15** *(9)*	**22** *(15)*		
Livestock	**19** *(11)*	**16** *(8)*		**6** *(4)*
Land management		**11** *(9)*	**10** *(9)*	
Water	**4** *(4)*	**12** *(8)*	**5** *(4)*	**3** *(3)*
Post-harvest and processing	**11** *(9)*			
Energy			**8** *(5)*	**9** *(5)*
Seeds	**4** *(3)*	**4** *(4)*		
Fertilizers/chemicals		**8** *(6)*		**3** *(3)*
Forestry			**3** *(3)*	
Fisheries		**4** *(2)*		
Agricultural tools			**1** *(1)*	**2** *(1)*
Other	**2** *(2)*			

Source: IOE.

166. The table above shows clearly that a positive impact on household incomes and assets, and on food security and productivity has been recorded for 10 main classes of innovation: seeds, livestock, crop type, post-harvest and processing, crop management, water, land management, fertilizers/chemicals, fisheries and other. Impact on environmental and natural resource management (ENRM) and climate change, and on gender and youth, has been more narrowly identified for seven types of innovation and in a much smaller number of countries. Innovations dealing with fisheries, forestry and agricultural tools are few in number and have been implemented in only a few countries.

Impact on household incomes and assets

167. The analysis of the impact of technical innovations examined evidence of impact in terms of the improvements made to household incomes and assets. Of the total sample of 416 innovations, 86 (21 per cent) were identified as having had a positive effect. Most of these (66) fell under only four technical areas: crop types, crop management, livestock, and post-harvest and processing.

168. **Positive innovation outcomes are inherently uncertain.** An examination of the proportion of innovations that result in identifiable impact reveals that in most countries (86 per cent), less than half of the innovations generate positive outcomes. Only one in five (20 per cent) of all countries experienced impact on household incomes and assets from more than half of the technical innovations implemented. The proportion of innovations with a positive outcome was the same (22 per cent) for both those assessed as being more technically complex and those that were low-tech; this proportion was slightly higher (24 per cent) for those innovations drawing on existing knowledge than those for which new knowledge was required (20 per cent).

Table 6
Analysis of countries and regions by percentage of innovations leading to a positive income result

Positive claims/number of innovations	*Number of countries*	*%*	*APR*	*ESA*	*LAC*	*NEN*	*WCA*
0	7	20.0	1	3	2	0	1
1% – 49%	21	60.0	7	6	1	2	5
50% – 100%	7	20.0	2	1	0	2	2
	35	100	10	10	3	4	8

APR: Asia and the Pacific Division
ESA: East and Southern Africa Division
LAC: Latin America and the Caribbean Division
NEN: Near East, North Africa and Europe Division
WCA: West and Central Africa Division
Source: IOE.

169. The seven countries with the highest rates of success were Azerbaijan [36], Cameroon [5], China [6], Morocco [1], Nepal [17], Senegal [21] and Uganda [23]. The characteristics of these seven cases in which higher levels of reported impact were found were analysed in further detail.

170. **A package of innovations led to increases in income and productivity in Azerbaijan.** The introduction of genetic improvements in cattle and beekeeping in particular (in addition to an increased supply of irrigation water and investments in agricultural extension services) led to significant production benefits for small farmers, and displayed strong potential to meet the need to improve the food security and income of small farmers [36].

171. **In Cameroon, improvements to food security, product value addition and the incomes of producers, through increasing productivity** came from disease-resistant and high-yielding varieties of rice, cassava and onion, as well as improved techniques for their production and processing. Cooperatives reported higher yields and higher selling prices, linking these gains in particular to the new crop varieties [5].

172. **In China, the introduction of new crop types and varieties through demonstrations was effective, overall**, achieving or exceeding targets and objectives, and having strong impact on household income and food security. For instance, Chinese purple yam introduced in Guangxi Province was adopted among poorer smallholder farmers, who often were thus able to achieve transformative increases in income. Similarly, IMP and zero grazing have benefited farmers financially and contributed to the sustainability of project benefits [6].

173. **An integrated investment geared towards value chain support, with new fruit and vegetable crops, livestock improvement, as well as processing units and equipment,** was effective in Morocco. Approximately 69 per cent of poor rural households were able to engage in one income-generating activity that boosted their income. Income-generating activities contributed 21 per cent of household income; these activities were, primarily, small ruminant production by women and, in certain areas, beekeeping and fruit trees [54].

174. **Innovative technologies applied to different legume crops resulted in substantial income increases (from 75 to 168 per cent)** in Nepal. ICRISAT collaborated with the Nepal Agricultural Research Council (and two NGOs) to introduce and test integrated crop management technologies that built synergies among pest, soil and nutrient management practices. Households also reported enhanced incomes from implementing other two innovations introduced, organic apple cultivation and production of vegetable seeds; however, dependence on a single trader controlling input supply and selling prices proved to be a limitation [17].

175. **Impact in Senegal came from a broad base of change.** Innovations in the country included better agricultural and pastoral practices through extension services, the development of varieties and other innovations related to demand-driven, collaborative research, and processing of products, and, to a lesser extent, irrigation techniques and adapted SRI. Until 2016, the programme's approach was based on consolidation and scaling up of innovations tested in completed or ongoing projects [21].

176. **The introduction of oil palm as a transformative cash crop generated major impacts on income** in Uganda, deriving from the employment of farmers on oil palm nucleus farms as well as from the improved land rights for smallholders and facilitated access to financial services. In addition, the introduction of small livestock activities (as well as the higher selling prices of farm products, given the construction or rehabilitation of community roads) was inferred to have effected substantial household income increases, albeit for the "not so poor". Finally, the introduction of improved crop varieties resistant to common diseases and pests allowed farmers to gradually transform their position, from that of purely subsistence producers to that of market-oriented farmers [23].

Key points

- Innovations with a successful impact on incomes were part of a broad set of measures, which were integrated, to some extent, and improved productivity by building on existing farming practices.
- However, these innovations often included a new enterprise or form of transformative diversification, which provided either new income opportunities or new opportunities for specific members of the household.

Food security and productivity

177. This analysis of the impact of technical innovations examined evidence of impact in terms of improvements to food security and productivity. Of our total sample of 416 innovations, 111 (27 per cent) were identified as having had a positive effect, while a small number (0.7 per cent) had effects that were detrimental. The data show no difference between the innovations with high or low technical content, and only a slight difference between innovations requiring new knowledge and those built on existing knowledge.

178. The examination of the proportion of innovations that result in identifiable impact reveals that in most cases (82.9 per cent), less than half of the innovations generate positive outcomes. Only 17.2 per cent of all countries experienced an impact on food security and productivity from more than half of the technical innovations implemented.

Table 7
Analysis of countries and regions by percentage of innovations leading to positive food security and productivity results

Positive claims/number of technical innovations	*Number of countries*	*%*	*APR*	*ESA*	*LAC*	*NEN*	*WCA*
0	5	14.3	2	3	0	0	0
1% – 49%	24	68.6	8	4	3	3	6
50% – 100%	6	17.2	0	3	0	1	2
	35	100	10	10	3	4	8

Source: IOE.

179. The six countries with the highest rates of success feature prominently in the analysis conducted on the basis of type of technology: Azerbaijan [36], Ethiopia [9], Kenya [13], Mauritania [52], Mozambique [16, 34], and Senegal [21]. Two of these countries also featured prominently in terms of impact on incomes.

180. **The evaluations confirm how benefits arise from combinations of innovations rather than sole initiatives.** For example, in Azerbaijan, fodder improvement was achieved through a combination of varieties, fertilizers and plant spacing, and in Senegal, by means of the introduction of improved varieties and production of certified seeds by producer organizations. In Kenya, the underlying driver was a blend of adequate – and available – technology choices, such as improved crop varieties, proven methods of improved soil fertility management and the introduction of better performing breeds of farm animals. In Mauritania, oasis development efforts focused on palm trees and vegetable crops, with support for water supply, varieties, tree management, and technology for crop processing and cooking. The key element to the success of these innovations appears to be the fact that they were well planned to build on local potential and existing practices, rather than the inherent quality of technical innovations. However, the evaluative evidence is unclear in this respect.

181. **The quality of data on crop yields is poor**. In all six cases, the evaluations report improvements made to productivity, with crop yields being mentioned in five cases. None of the evaluations report data from evaluation surveys; rather, the estimates appear to derive from farmer interviews or project reports. Two projects record benefits from crop diversification; however, overall, there is little analysis of consumption or nutrition or of their effects on food shortages.

182. **Three of the six evaluations report that the project in question included a specific aim of introducing new technology, either in the COSOP strategic objectives or in the project objectives**. There are also links to enabling factors, with finance and research emerging as the primary factors that create the conditions for successful adoption of the innovative technology. The evaluations conducted in in Azerbaijan and Mozambique both identify forms of rural finance, microcredit and innovative financing mechanisms as being contributory factors.

183. **The strength of project links with research institutes is emphasized** in Mauritania and Senegal: in Mauritania, in the context of thee pollination of palm trees; and in Senegal, in connection with the introduction of a demand-driven competitive research system. The most interesting example occurred in Mauritania (the Oasis Sustainable Development Programme), in which a significant enabling innovation was the establishment of a farmer-based extension system through a South-South initiative; the extension system involved exchange visits lasting six months with households living in the oases of adjacent Morocco.

184. The project successfully introduced diversified vegetable and fruit crops; in addition, the training provided by women had real and immediate impact (in terms of women's attitudes and social position, culinary recipes based on locally available

products, market gardening, income-generating activities and crafts). This impact was also reflected in health benefits deriving from the diversification of meals and the improvement in the diet of households (and children, in particular) [52].

185. **Additional examples of impact on both incomes and food security may also be seen.** Among 18 innovative technologies implemented through five projects in The Gambia [10], the introduction of cassava and sweet potato and enhanced vegetable production were found to have a lasting positive impact on household food security and on the generation of marketable surplus.

186. In Ghana, most innovations were not technical but, rather, financial or institutional. Ten innovations have been identified, across nine projects. There was no clearly defined strategy for technical innovations. However, a country-specific grant, the Sustainable Up-scaling of Seed Yam and Cassava Production Systems for Small-Scale Growers in Ghana (funded by the European Union Food Facility Programme), issued in response to severely escalating food prices in 2008, sought to strengthen and modernize the production of cassava and yam through disease-resistant planting material. This was envisaged to enable smallholder farmers increase their production and to open up income-generating business and employment opportunities for rural families. The efforts were successful, with new technologies being developed and disseminated through the project [11].

187. **The underlying driver of agricultural productivity was a mix of adequate – and available – technology choices** in Kenya [13]. Productivity on small farms has improved over the last five years, with the average yield of maize increasing from 1.5 to 3 tons per hectare. The innovations introduced included improved crop varieties, proven methods of improved soil fertility management and the introduction of better performing breeds of farm animals. Intense awareness-building, training and coaching, and the building up of social capital by farmers (including women) were crucial additions for the impact observed, which displayed the potential for replication.

188. **Water control linked with SRI has shown strong results.** In Madagascar, improved water control and SRI were taken up in two projects. According to one self-assessment report [2], the combined effect of hydro-agricultural developments (4,330 ha or 206 per cent of the forecast) and the adoption of intensive or improved rice systems through FFSs led to a productivity increase in rice yields (from 500 kilograms to 3 tons per hectare, in some cases). In another project [3] self-assessment report, a significant increase in production may be observed for all major crops through water control, the introduction of improved seeds and the adoption of SRI. Indeed, the yields evolved significantly compared to the situation before the project: the yields increased three times for rice and almost doubled for beans, peanuts and lentils. The evaluation indicates that crop intensification was good, and that research was available on the matter. However, given that strategies for conservation and integrated watershed management were absent, the negative impact of technical innovations on NRM increases within a context of an increasing risk of drought and soil erosion. Furthermore, the CSPE identified that IFAD-supported projects do not have sufficient funds to deal with basin management and environmental protection.

189. The experience of Lesotho's Sustainable Agriculture and Natural Resource Management Programme is interesting. A small number of innovative technologies were promoted within a wider programme of agricultural development: practices to prevent land degradation (including biological and structural measures); pasture reseeding for better-quality grazing areas; genetically improved rams and bucks; new fruit and vegetable varieties; and the introduction of beekeeping. The PPA field observations identified strong, although only anecdotal, evidence that household food security benefitted from the programme's activities, particularly with regard to fruit trees, crops, vegetables, poultry, pigs, and sheep and goats.

Key points

- As for the impact on incomes, successful innovations were part of a package of measures that were integrated, to some extent, and that built upon existing farming practices.
- Several results also reflect a declared intervention strategy aimed at promoting new technology and the integration of technical change with the enabling of financial services.
- The incorporation of links to research institutions to support the innovative technology is also important.
- In some instances, food security is clearly linked to improvements in household diet, with a positive impact on women and children.

Impact on ENRM and climate change

190. Only a small proportion (15 per cent) of innovations were identified as having a positive effect on ENRM and climate change; a smaller number (5 per cent) had effects that were detrimental. A higher proportion of positive outcomes were reported for innovations with highly technical content (16 per cent) than those with low-tech content (12 per cent). A slightly higher proportion (14 per cent) was found in those requiring new knowledge than in those drawing on existing knowledge (12 per cent). The evaluation synthesis on Environment and Natural Resource Management (2016) noted that environmental risks were often overlooked or that they were not assessed or taken into account. This indicates a risk for IFAD, in that poverty may be reduced and incomes raised at continuing costs to the environment.

Table 8
Analysis of countries and regions by percentage of innovations leading to a positive ENRM result

Positive claims/number of technical innovations	*Number of countries*	*%*	*APR*	*ESA*	*LAC*	*NEN*	*WCA*
0	12	34.3	4	4	0	3	1
1% – 49%	22	62.9	6	5	3	1	7
50% – 100%	1	2.9	0	1	0	0	0
	35	100	10	10	3	4	8

Source: Prepared by IOE.

191. Only one country [Ethiopia, 9] of the sample experienced impact on ENRM and climate change from at least half of its implemented technical innovations. To understand the reasons for this scarcity, countries with a lower success rate were analysed.

192. The many different innovations identified that may have positive impacts on NRM can be grouped under three general clusters: (i) alternative energy sources; (ii) introduction of species and technologies that were more compatible with climate change; and (iii) soil and water conservation measures.

193. **The introduction of biogas technology, improved stoves and alternative energy sources** had positive impacts on ENRM. Specifically, the use of biogas technologies reduced pressure from deforestation and limited soil erosion; the promotion of improved cooking stoves further reduced wood consumption.

194. In Ethiopia, beneficial impact arose from the introduction of more efficient woodburning stoves and new biogas plants, which were adapted for the preparation of *injera*. In Bangladesh [1], biogas units contributed to reducing fuelwood consumption by 1.5 to 2 tons per year. In Ghana [11], waste from

cassava processing was used to produce energy, reducing the environmental pollution derived from cyanide-rich cassava effluents.

195. The introduction of improved stoves in Rwanda [57] reduced the use of firewood by more than 30 per cent compared to traditional open stoves. The use of biogas technologies for cooking and lighting further contributed to efforts to relieve the pressure on natural resources. Environmentally friendly alternatives were introduced in Senegal [21] for the processing of *néré*, *cajú* and *karité* crops. Improved bakery ovens and *néré* steamers contributed to the reduction of the energy consumed in processing.

Box 4
A post-harvest environmental innovation

> In Mali [15], *chorkor* ovens were introduced to smoke fish. The technique, which was developed in the 1980s in Ghana and then in Senegal, allows a reduction in the quantity of wood used because the smoking time is reduced. The installation of *chorkor* kilns and dryers was a success, because the process of fish smoking is difficult to improve: the manpower necessary for handling and maintenance is significant. However, there is no evidence of improvements to productivity or incomes deriving from this innovation.

196. **Several innovations were promoted as adaptation measures to climate change.** These include water harvesting structures in response to drought [18], pasture management techniques [21], pasture reseeding [50], crop varieties adapted to the local environment [5, 18, 52, 59], crop rotation and other climate-resistant practices, including shade-cloth greenhouses and crop calendars [4, 16, 21, 55].

197. In Mauritania [52], the negative effects of climate change in the oases were mitigated by the introduction of different palm tree varieties, combined with efficient water management. In Cambodia [4], crop calendars and crop diversification helped farmers to cope with the effects of climate change. Similarly, the introduction of sea beans (*mukuna*) in the Democratic Republic of the Congo [7] as a cover crop in the rotation cycle contributed towards increasing the fertility of savannah soils and limiting pressure on gallery forests.

198. **Soil and water conservation measures.** The main innovations under this cluster include a number of interventions aimed at reducing soil erosion, such as tree planting [5, 20, 41, 42, 55, 57], planting of fruit trees [43], planting of fodder trees as hedgerows [57], and establishment of nurseries [41]. Reduced use of fertilizers, use of composting and farmyard manure, and mulching reported impacts on soil fertility [4, 18, 46, 55]. The interventions often included water conservation measures, such as drip irrigation [4, 18, 46, 55], which resulted in important water savings.

199. **Drip irrigation, water harvesting and new crop species and varieties were identified as having positive impacts on the environment** in Nicaragua [55]. A wide range of environmentally friendly innovations were introduced. In Egypt [8], innovative farming systems generated environmental benefits, reaching savings of 20 to 30 per cent in fertilizer use and of 7 to 19 per cent in water use.

200. **Conservation farming and the promotion of non-timber forest products were found to have some impact** among seven innovative technologies in Zambia [25]. The planting of trees on slopes in Viet Nam [59] was promoted to mitigate soil erosion and improve water infiltration, and thus further reduce the risk of flooding.

201. **Conservation practices that would support the best use of local species and regenerate vegetation, preventing soil erosion, were introduced** in Brazil [41]. Planting of seedlings and reforestation contributed to the reduction of deforestation, which was a major concern for beneficiaries. In Rwanda [57], soil

and water conservation measures were adopted in combination with planting of fodder trees, contributing to the reduction of soil erosion and loss of valuable soil. Soil water retention capacity was also improved through mulching of fields, while planting nitrogen-fixing trees as hedgerows and the application of manure enhanced soil fertility. In Cameroon [5], contour planting was introduced in combination with the use of attack-resistant varieties and organic fertilizers to improve soil water retention.

202. **Livestock resilience at pasture was increased** by the introduction of fodder grass in the land use system in Viet Nam [59]. Similarly, in India [47], Napier grass production for fodder had a significant impact on the environment, contributing to the reduction of overgrazing in communal areas and of damage to common property resources in the daily collection of fodder. In China [6], the introduction of zero-grazing livestock production reduced pressure on natural pastures.

203. In Lesotho [50], the programme implemented several measures to reclaim degraded areas, rehabilitate pastures and graze lands, and promote conservation agriculture. Positive impacts were reported in terms of increased soil fertility, reduced soil erosion and increased awareness among beneficiaries on natural resource and environmental protection. A more efficient use of natural resources was also achieved through the integrated approach promoted by the project. Pasture regeneration was also promoted alongside other interventions in Mali [15], within the scope of the *bourgou* plains regeneration efforts. The construction of stone barriers and half-moons sought to foster water infiltration and soil conservation.

204. **Balancing the positive benefits of technical innovations with actual or potential damage to environmental and natural resources is challenging**, as several examples illustrate. In Egypt, modern irrigation systems were introduced without adequate regard for the longer-term potential for salinationDrip irrigation, which requires precise and timely implementation, was introduced in locations where supplies are uncertain; crops subsequently showed signs of water stress [46]. Irrigation in oases in Mauritania [52] is expanding; however, the locations have slow recharge rates and further monitoring is required to manage the system.

205. **Evidence from China indicates a concern that improvements in productivity have involved a more intensive use of inorganic fertilizers and pesticides, with a negative impact on human health**. Similarly, in Madagascar, effective crop intensification took place without a strategy for conservation and integrated watershed management, leading to concerns about increases in drought and soil erosion. The regeneration of flood plains in Mali was successful; however, the resulting increase in grazing herds has brought about new pressures, for which further remedial actions are required.

Box 5
The importance of understanding the setting to achieve net benefits

> Drip irrigation and the conversion of open (canals) to closed (pipe) systems has led to reduced water loss because of evaporation. This is likely to have a positive impact on climate change resilience. However, such impact is relatively small compared to the effects on the reliability of the upstream water supply, which is affected by: (i) climate change; (ii) upstream use by riparian countries in the Nile basin; and (iii) the irrigation system management (efficiency, distribution, reliability).
> Egypt, West Noubaria Rural Development Project PPE

206. **Cassava processing has helped farmers achieve a higher value in Cameroon [5] and Ghana [11]; however, dealing safely with processing effluents is a cause for concern.** Projects in those two countries, as well as in the Democratic Republic of the Congo [7] and in the Lao People's Democratic

Republic [49], have intensified cropping and introduced modern varieties. This has placed indigenous crops under pressure and has reduced biodiversity or soil fertility, contributing to deforestation.

207. **The introduction of improved breeds or processing technology has expanded grazing numbers in Bolivia [2] and Viet Nam [59], bringing about overgrazing and the attendant potential for soil erosion.** Last, solar power and biogas were introduced in Jharkhand-Chhattisgarh, in India [47], as a step towards forest protection and climate change adaptation. However, uptake was limited and stalled when the project finished, leaving the forests as the main source of fuel.

Key points

- Only 15 per cent of the technical innovations were identified as having a positive effect on ENRM and climate change; a smaller number (5 per cent) had detrimental effects.
- Where adopted, alternative energy sources have demonstrated real impact. However, biogas has substantial limitations in terms of access to raw materials, demands on labour and suitable climate, and therefore is likely to be a niche technology at best. In contrast, improved stoves have widespread application.
- Transformative innovations have an evident potential to help efforts to adapt to climate change. The few examples examined in this ESR merit further exploration and analysis.
- The broader category of improvements to assets through soil and water conservation reflects longstanding historical interventions to contain soil erosion and harvest water.
- Negative outcomes feature more prominently in terms of actual or potential environmental damage, and indicate the need for careful monitoring of otherwise successful interventions.

Impact on gender[25] empowerment and equality

208. Of the 416 innovations identified, 33 (7.9 per cent) were reported as yielding a positive impact on gender equality and women empowerment, while a small number (0.9 per cent) were reported to bear a negative impact. A slightly higher proportion of high-tech innovations reported positive outcomes (10 per cent) than of low-tech innovations (8 per cent). Positive outcomes were reported in 9 per cent of innovations drawing on existing knowledge and in 8 per cent of those requiring new knowledge.

209. Out of the entire sample, only one country, Ethiopia, reported an impact on gender from more than half of the technical innovations implemented. A lower success rate (25 to 49 per cent) was identified in Bolivia, Brazil, India and Nigeria.

[25] Impacts on youth were reported only with reference to beekeeping [19] in Nigeria. According to the evaluation document, beekeeping, in conjunction with other livestock interventions, attracted young people, generating a life-changing impact through increased incomes. The innovation also fostered employment opportunities, which further contributed to the reduction of youth migration.

Table 9
Analysis of countries and regions by percentage of innovations leading to a positive gender and youth result

Gender claims/number of technical innovations	*Number of countries*	*%*	*APR*	*ESA*	*LAC*	*NEN*	*WCA*
0	24	68.6	6	8	1	4	5
1% – 49%	10	28.5	4	1	2	0	3
50% – 100%	1	2.9	0	1	0	0	0
	35	100	10	10	3	4	8

Source: IOE.

210. The following section is organized according to the three main objectives of the IFAD Policy on gender equality and women's empowerment: (i) promote economic empowerment to enable rural women and men to have equal opportunity to participate in, and benefit from, profitable economic activities; (ii) enable women and men to have an equal voice and influence in rural institutions and organizations; and (iii) achieve a more equitable balance in workloads and in the sharing of economic and social benefits.

211. **Promote economic empowerment.** The analysis identified a number of cases in which access to technological improvements and productive assets enhanced gender equality and women's empowerment.

212. **Home gardens were reported as being beneficial to rural women, contributing to improved food security and living standards, as well as to increased income through sales at markets.** A number of technical innovations were introduced in relation to home gardens, including water-saving techniques and cisterns [41] and the production of fruit [41] and vegetable crops [2]. In Bolivia, home gardens were introduced in combination with other innovative activities, such as production of compost, improved stoves and greater care of livestock; the efforts targeted women specifically, with the aim of increasing their incomes and their families' nutritional status. In Brazil [41], backyard gardens were promoted as an income-generating activity for female beneficiaries, who gained access to and control over household income for the first time. In Ethiopia [9], home gardens reported similar impacts, benefitting landless women specifically.

213. Fruit and cassava processing was introduced in Brazil [41] and experienced the active participation of women, who benefitted from increased income. Integration into value chains through processing was also reported in Nigeria [19], where the project promoted cassava processing into flour for bread, mainly a female activity (95 per cent of the beneficiaries were women).

214. **Reducing time poverty and drudgery for women was conceived as a precondition for improving health, increasing productivity and fostering women's involvement in society.** The aim of several technical innovations was to reduce time poverty and drudgery among women. This implied acting on the root causes of such phenomena, both at the productive and the household level (e.g. reducing the domestic workload and the time spent on household chores).

215. As rural household chores performed by women often involve fuel collection and food processing and preparation (IFAD, 2016), eco-efficient stoves and biogas digesters were introduced as labour-saving technologies in a number of countries [3, 9, 47, 57]. In the case of Rwanda [57], the introduction of improved stoves and domestic biodigesters had a positive impact on women's health by mitigating the issue of smoke in the kitchens, caused by the absence of chimneys and the use of firewood. Similarly, in Ethiopia [9], the introduction of improved stoves reduced women's workload, while also improving living and hygienic conditions. However, reportedly, the biogas technology did not benefit female beneficiaries, who often lacked the necessary livestock and manure.

216. **The cultivation of fodder crops was introduced to reduce the time spent by women in collecting fodder**. In the Lao People's Democratic Republic [49], forages and feed crop (e.g. cassava) were planted to reduce the time spent in collecting and preparing pig feed. The PPE indicates that the time dedicated to collecting and preparing pig food was reduced to 1.2 hours a day, in comparison with the required time of more than two hours before the fodder crops. The innovation was supported by extension services in the form of technical training. In India [47], Napier grass was introduced to prevent women from collecting natural grass from the forest. This reduced the time spent by women on collecting fodder by 60 per cent.

217. **Water-related innovations showed one of the highest success ratios, in terms of gender impact**. As women are often responsible for water collection, their workload was reduced by the introduction of irrigation and drainage systems (specifically, drip and valve irrigation) [52]. In India [47], heavy metal pitchers for water collection were replaced by lightweight pitchers, reducing water collection time by 30 per cent. The improved pitcher weighs only 1 kg, as opposed to the 5 kg of bronze pitchers, and contains more water (17 litres against 15 litres). All women interviewed during the PPE reported that the pitcher was more comfortable to carry, therefore reducing time and labour, with positive effects on their health.

218. Adapted agricultural tools were introduced in India [47] in combination with other drudgery-reduction interventions, including vermicomposting and the abovementioned water pitchers, Napier grass and improved firewood sources. These technologies reduced the daily amount of time spent on household chores by five hours.

219. The ouricoury processing machine helped to reduce the workload among women, adapting machinery that was previously used for livestock feed. This technology allowed women to decrease the painful manual work of breaking the fruit with two stones, while also improving the quality of the product [3].

220. Drudgery reduction was not achieved in the case of Viet Nam [59], where a number of female beneficiaries highlighted that the introduction of cash crops, such as canna, were actually increasing their workload (as harvest happens in winter, at the same time with rice harvesting). As a consequence, not all of them felt that they had enough time to participate in project activities.

221. **In a limited number of cases, technical innovations fostered women's involvement in the household decision-making process and contributed to the achievement of a higher societal status**. Women benefitted from the pass-on scheme for livestock implemented in Rwanda [20]. The introduction of improved breeds through this solidarity chain improved incomes and living standards, which in turn affected the social status of beneficiaries. As women became donors of heifers, their self-confidence increased and allowed them to participate in the community decision-making discussions. It should be noted, however, that the distribution of livestock required a contribution from the beneficiaries. This represented a constraint for the most vulnerable women-headed households, who could not afford to pay this contribution (see the 2009 mid-term review [MTR]).

222. In Bangladesh [37], the project introduced vaccination for poultry and livestock. The trained poultry vaccinators were all women. The provision of such technical training, together with microcredit, generated an important impact on household-level gender relations and helped expand the role of women inside and outside the home. Women benefitted from increased mobility, improved participation in family decision-making and greater control over revenues from project activities.

223. Similarly, the introduction of improved seed preservation techniques (the Maria model, for rice) and the use of pheromone traps in Bangladesh [38] had the double effect of reducing expenditures for fertilizers and seeds while enhancing incomes.

As women acquired and adopted these new technologies, they gained an increased status at both the household and the community level.

224. In Ethiopia [9], small-scale irrigation allowed women to increase their incomes and pitch their voices in the communities. However, land ownership constrained women participation, as it is not common for wives of farmers to own land in their own names.

Key points

Despite the low number of impacts reported, a wide range of beneficial changes were observed:

- less than 10 per cent of technical innovations in most categories were targeted specifically towards women (and almost none towards youth).
- the wider discussion of **gender** aspects in evaluations often fails to link impact to innovation.
- economic empowerment is associated with tools and opportunities to process crop and animal products and secure higher value, and with some improvement and diversity in diets in light of the new crops;
- skills training to operate specialist equipment, sometimes combined with providing a village-based service to other farmers, is recognized as bringing increased economic participation and self-esteem;
- improved stoves are associated with a reduction of labour through access to improved water supplies, more efficient provision of fodder and a reduced need for firewood.

Impact on human and social capital

225. Looking beyond the direct benefits reported above, the synthesis explored evidence of the impact of technical innovations on human and social capital. These aspects are rarely a central focus of interest during CSPEs and PPEs; therefore, well-documented examples are not common. However, a number of interesting findings do emerge. Although numbers are low, approximately 8 per cent of positive findings were associated with low-tech innovations, compared with the 3 per cent of positive findings associated with high-tech innovations.

226. **Social and productive groups not only enable innovations to take hold; they may also strengthen social cohesion and self-reliance**. In Nicaragua [18], the project intervention strategy, with its participatory approach and links to academic research, generated important processes of social mobilization and knowledge-sharing among the men and women beneficiaries, advancing the common good. In Morocco [54], the technical innovations aimed to foster an incipient value-chain approach. The innovations encompassed the introduction of new crop types, livestock improvements, as well as processing units and equipment. The oil extraction equipment for walnuts and aromatic and medicinal plants, procured jointly with other projects, not only improved the quality of agricultural products; it also increased the professionalism of farmers, despite some setbacks regarding market access. In Cameroon [5], the programme focused on a value chain approach, applied in sectors with strong economic potential (cassava, onion and rice). The human and social capital of the target groups increased through numerous technical training courses and support for various forms of community and producer organization. Additionally, the successful experience with FFSs was capitalized upon by compiling a manual, which appears to have been widely disseminated.

227. **Not all groups are sustainable.** In Zambia [25], the project helped transform the organizational capacities of the target communities through sensitization, community mobilization and group formation. Although the formation of these local

institutions empowered some communities to register their groups as legal entities, these groups became dysfunctional after the project ended.

228. In Mozambique [16], the support provided to cassava production in partnership with the Mozambique Institute for Agricultural Research and the Alliance for Green Revolution in Africa helped stimulate the registration of land use and utilization rights, achieving 3,923 registrations (thus far exceeding the target of 750).

229. In Nepal [17], one of four countries to participate in a regional grant to ICRISAT for the improvement of grain legumes in rainfed systems, the results led the Nepal Agricultural Research Council to develop a document on a vision and strategies to improve grain legume production for livelihoods, food security and poverty alleviation in the country. Even more promisingly, in the Democratic Republic of the Congo [7], lessons from two projects – which focused mainly on improving access to improved seeds and setting up local seed production systems involving farmers' organizations and public research and monitoring institutions – were instrumental in the elaboration of a national strategy for seed development and the preparation of legislation on seeds, which is awaiting promulgation.

Key points

The few examples illustrate potential in two main ways:

- enhancing social capital and self-reliance through a combination of technical training, exposure to markets and an appreciation of production and processing quality and standards;
- stimulating institutional change, at times in recognition of individuals' rights, or to establish a legal framework, such as for the supply of quality seeds.

E. Sustainability

230. Three main factors were identified as affecting the sustainability of technical innovations: (i) government support; (ii) technical and financial viability, including the availability of supply, required maintenance and related costs; and (iii) environmental resilience, with a specific focus on post-project risks.[26]

Government support

231. **The role of national governments in supporting technical innovations in the long term was identified as key in a number of evaluations** [1, 14, 19, 20, 33, 37, 54, 59]. Specifically, governments can play a role in sourcing of specialist inputs and continuing financing after project closure.

232. In Bangladesh [1], line departments (the Department of Agricultural Extension and the Department of Fisheries) were expected to continue the provision of technology for crop intensification, poultry production and rice improvement, in partnership with national and international research institutes. Within the Microfinance and Technical Support Project, implemented in Bangladesh [37], the sustainability of livestock vaccination for poultry and large ruminants was dependent on an adequate supply of vaccines from the Department of Livestock Services.

233. The lack of government ownership in Rwanda [20] hampered the sustainability of watershed protection interventions. The institutions created to temporarily manage the watersheds (the local watershed management and supervision committees) were found to duplicate the functions usually attributed to local administrative bodies, rather than enhancing the process of developing the capacity of local governments. In India [33], the sustainability of livestock production improvement required stronger linkages with line departments, efforts that were not promoted by the project. In Morocco [54], the Government indirectly affected the

[26] In addition to these three factors, annex X also covers enabling factors and their sustainability in relation to technical innovations.

sustainability of livestock interventions by drastically reducing public subsidies for animal feed and vaccination.

Technical and financial viability

234. **The affordability of innovations is imperative**. In a number of cases, the sustainability of technical innovations was linked to their technical and financial viability [1, 2, 5, 6, 10, 11, 14, 16, 34, 37, 38, 45, 48, 52, 56, 57]. Low specification items, local manufacture and minimal maintenance all help keep costs down.

235. In The Gambia [10], the financial viability of an integrated poultry-aquaculture scheme was assured by the low-cost poultry housing, made of cheap and locally available materials. Similarly, local production of mineral licks ensured a supply stream for multinutrient licks and mineral blocks, as well as additional income for traditional village group farms. In Bangladesh [37], locally available inputs, combined with low levels of investments, contributed to the replication and adoption of mini-hatcheries by non-targeted households.

236. In Madagascar [14], SRI and improved rice cropping techniques were considered potentially sustainable because of the low maintenance and operation costs required. Similarly, in Bolivia [2], the sustainability of the innovations introduced was attributed to the low maintenance costs, both in terms of financial investment (for home gardens, improved stoves, improved livestock management and potato cultivation) and labour (for tilling the soil on contours and composting).

237. On the contrary, the cost of shade-cloth houses in Mozambique [16] prevented them from becoming a viable investment for the beneficiaries. In addition, the sustainability of alternative fishing equipment was constrained by its limited availability (for sale only in large urban centres), which resulted in increased costs for fishermen [34]. In the Democratic Republic of the Congo [45], solar pumps were not maintained because of the high operating costs and the required change of batteries and maintenance of photovoltaic panels. This represented a constraint for farmers, who preferred hand pumps.

238. In Pakistan [56], the introduction of improved seeds was not supported by a sustainability strategy, which left farmers dependent on the programme and on the Department of Agriculture for the provision of inputs. Similarly, in Rwanda [57], the lack of planting material constrained the impact of hedging, limiting its long-term sustainability.

Environmental resilience

239. **Some innovations enhance environmental sustainability; others may be subject to risks arising from the environment.** The environmental sustainability of technical innovation was reported in some instances [2, 14, 38, 46, 51, 54]. In Bangladesh [38], for example, simple and low-cost innovations were introduced (urea super granules [USGs], pheromone traps, leaf-colour charts and improved rice varieties), which contributed to the reduced use of agrochemicals, fostering environmental sustainability.

240. Even where the innovation is workable, the context may undermine sustainability. Despite good technical and financial viability, the sustainability of SRI and rice system improvements in Madagascar [14] could be hampered by floods and soil erosion. Similarly, in Egypt [46], the sustainability of drip irrigation was undermined by the increasing water scarcity affecting the region. In Morocco [54], the introduction of *sardi* stud rams for genetic improvement successfully contributed to the intensification of livestock production. However, the sustainability of these benefits could be constrained by the effects of drought.

241. In Malawi [51], the environmental sustainability of improved techniques for maize cultivation was hindered by soil degradation. The focus on monocropping,

promoted by the Government, was not deemed suitable to maintain soil fertility, further reducing the resilience of the agroecosystem.

Key points

- Identifying the suitable partner(s) in government and ensuring that the correct institutional set up is established is key to continued government support.
- The affordability and availability of the technology in the local area, as well as low operation and maintenance costs both in terms of finance and labour, determine the sustainability of innovations after project closure.
- While some innovations promoted were environmentally sustainable, more were subject to risks deriving from the environment or could damage the environment (e.g. floods and soil erosion, water scarcity, drought, soil fertility).

F. Scaling up

242. In IFAD, the most recent definition of scaling up (IFAD 2015) refers to: (i) expanding, adapting and supporting successful policies, programmes and knowledge so that they can leverage resources and partners to deliver more results for a greater number of rural poor in a sustainable way; however, (ii) scaling up results does not mean transforming small IFAD projects into larger projects. Instead, IFAD interventions focus on how successful local initiatives will sustainably leverage policy changes, additional resources and learn to bring the results to scale. In reality, many projects and subsequent evaluations document a replication of innovations from one IFAD project to a second phase. For this reason, replication is included in this analysis. Replication is a positive step in the dissemination of innovations and is akin to extended testing. It may be a precursor to scaling up.

243. The evaluation synthesis on IFAD's Support to Scaling Up of Results (2016) emphasizes a number of characteristics that facilitates scaling up. Among these are focused and well-conceived project designs, evidence on project outcomes and impact. However, monitoring and evaluation (M&E) is a weak aspect of most projects. Weak M&E efforts, coupled with the chronic problem of slow implementation pace during the first three to four years, results in limited evidence of successful aspects and of the elements that could be scaled up and in what conditions, until the late stages of the project cycle. The report also notes that the issue of scalability has not been acknowledged forcefully enough (i.e. certain interventions may present economies or diseconomies of scale; they may be successful or cost-effective only at a certain size; complementary interventions may need to be introduced as the size changes).[27]

244. The scaling up of technical innovations introduced in IFAD-financed projects was undertaken in 13 countries, mostly in the APR, ESA and WCA regions (four countries in each region), and, to a lesser extent, in LAC and in the Near East, North Africa and Europe (NEN) region (one country in each sub-region). Three aspects were considered for the purposes of this evaluation synthesis, and the results presented below are divided accordingly: (i) replication of technologies in follow-up or subsequent IFAD-financed projects; (ii) "appropriation by partners", referring to the scaling up of innovations by IFAD's partner organizations or governments; and (iii) "practice to policy", which captures the incorporation of technical innovations into government policies. In addition, this section also covers cases of (iv) "spontaneous adoption", denoting the voluntary, self-motivated uptake of innovations by non-beneficiary farmers by way of observation and peer-to-peer learning and knowledge transfer. A further subsection describes several

[27] For example, the ESR highlights the success of research and extension activities generating and disseminating new varieties of cassava that were resistant to the mosaic virus in West Africa. They were initially funded by IFAD and CGIAR, and other multilateral and bilateral donors provided additional support. However, extension activities resulted in significant surplus production. In the absence of improved processing technology, one of the downsides of this success consisted in the diminishing farm-gate prices of cassava in several countries.

cases of missed opportunities for scaling up innovative technologies and practices, as assessed in the respective evaluation reports.

Replication

245. **Replication was the most frequently encountered modality of scaling up,** covering a number of innovations across seven countries [1, 4, 9, 12, 14, 19, 57].

246. In Bangladesh, portable biogas units were trialled successfully in one project and were piloted in a subsequent IFAD-financed project based on the results achieved (reusing effluent from livestock, estimated savings in use of fuelwood of 1.5 to 2 tons per year were achieved) [1]. The same evaluation report further stated, in general terms, that several other agricultural technologies trialled within projects were later expanded to many parts of the country; however, the technologies were not further specified [1]. In Ethiopia, biogas was replicated in a follow-up IFAD project having national coverage. The follow-up project also replicated other innovative approaches, such as community-based natural resources management, land certification and participatory forest management [9].

247. Replication of pheromone traps and livestock vaccinations, introduced in Bangladesh [37, 38] through the local Palli-Karma Sahayak Foundation NGO, was reported in a subsequent IFAD project in Bangladesh - the Finance for Enterprise Development and Employment Creation project (FEDEC). Through its microenterprise loans, FEDEC launched 42 subprojects that provided technical services to a larger number of farmers, including both the promotion of pheromone traps and livestock vaccination (IFAD, 2017 – Occasional Paper 18).

248. **The introduction or subsequent replication of technical innovations was at times fostered by grants** [4, 12, 14, 19]. For example, in Jordan, improved water-harvesting techniques (developed under a grant with the International Centre for Agricultural Research in the Dry Areas – ICARDA) were replicated in a subsequent IFAD-financed project [12]. Similarly, an IFAD grant to WorldFish in Bangladesh [1] fostered the productivity and use of *mola* fisheries. A follow-up large grant was approved in 2017, in support of the "nutrition-sensitive fish food systems pillar" of WorldFish, to expand the experience gained in Bangladesh to Cambodia, Myanmar, Thailand and Zambia (IFAD, 2018).

249. In East and Southern Africa, a grant to the IFADAFRICA network enabled knowledge exchange between Madagascar and other countries, in that the system of rice intensification was transferred from Madagascar to Rwandan rice growers, who, in turn, trained rice farmers in Burundi [14].

250. In Nigeria, the positive experience gained with introducing cassava processing (into flour) was further supported by a number of subsequent grants: (i) a regional grant led by the Natural Resources Institute aimed to improve the performance of the cassava industry by way of further research and dissemination of innovative practices for cassava processors, which were to be adopted by IFAD programmes in the WCA region; (ii) a grant to the International Institute of Tropical Agriculture aimed to increase cassava-based household incomes, contributing to employment creation and the reduction in wheat import expenditure by transforming cassava roots into high-quality edible flour; and (iii) a grant supported the Government's flagship programme to develop the cassava bread subsector, coordinated by the Federal Ministry of Industry, Trade and Investment and the Federal Ministry of Agriculture and Rural Development, inter alia by providing training to bakers, caterers, and extension and research staff on high-quality cassava flour [19].

Appropriation by partners

251. Scaling up in the form of appropriation by partner organizations and governments was reported in four countries [1, 5, 9, 12].

252. In Bangladesh, sand-based mini-hatcheries for poultry were introduced in one project and subsequently disseminated to a larger area through partner NGOs of a

financial institution founded by the Government, which was one of the main implementing agencies for the project. The spontaneous adoption of mini-hatcheries by non-beneficiary farmers was also documented [1].

253. In Jordan, results from grant-supported research – specifically, the identification of salt-tolerant varieties of fodder crops and improved water-harvesting techniques – were disseminated in some cases by programmes supported by the government and international donors. By the same token, soil and water conservation investments were replicated in a few areas from government resources; regardless, it was noted that their expansion to a larger national programme would have required a more concerted effort in the initial project and, more importantly, in scaling up to other projects [12].

254. In Cameroon, a follow-on project entirely funded by the Government continued to promote the multiplication of quality cassava cuttings and selected varieties [5].

255. In Ethiopia, affordable, small-scale irrigation technologies were scaled up by a multi-donor programme led by the World Bank [9].

Missed opportunities

256. Missed opportunities to consistently and systematically replicate a number of promising technical innovations in later generations of projects or in new target areas came to the fore in Egypt. The innovations included the successful approach to irrigation and drainage development, together with effective environmental monitoring, the introduction of solar power and integrated environmentally sound farming systems [8].

257. In Senegal, a lack of financial resources was identified as a major hindrance to scaling up innovations, despite the potential political will. There was also little success in advocating for partnerships and securing support from cofinancers, as well as poor coordination and limited mediation capacity on the part of the Ministry of Agriculture and Rural Equipment; this element was considered pivotal in this context [21]. Similarly, in Brazil, it was found that broader partnerships with a range of federal government agencies (in addition to the strong existing partnerships with the Ministry of Livestock, Agriculture and Food Supply and the Ministry of Planning, Development and Management) were an important factor to be considered for future scaling-up efforts, as such agencies possess a national perspective and are therefore well-placed to identify successful innovations in individual states and scale them up in others through national policies and programmes [3].

Practice to policy

258. **National extension programmes were found to be primary actors driving the acquisition of innovations at the policy level**. Policy-level scaling up was reported in four countries [12, 16, 20, 57, 59].

259. In Jordan, technological, institutional and policy approaches for improved water-harvesting and crops-rangeland-livestock integration, which had been tested in two regional grants cofinanced by IFAD, contributed to the design of a restoration programme for the Jordanian steppe. However, progress with the policy uptake of the results was limited, specifically for improved water harvesting techniques [12].

260. In Mozambique, the innovative biological control of the diamondback moth was integrated into national programmes and standards, and scaled up through the national agricultural extension service. This pest management approach had been introduced through a successful collaboration between IFAD-funded regional grants and a project supporting the Government's National Programme for Agricultural Extension. Adoption of this technology was causally linked to the enhancement of produce quality and productivity [16].

261. In Rwanda, while individual projects helped to promote emerging agricultural innovations, the long-term challenge for scaling up such innovations was to find an

institutional approach that would fit into the decentralization process and local government structures [20]. One of the innovative practices successfully adopted at the institutional level was the hedge planting of fodder crops on bunds for soil conservation, which was taken up by the national agricultural extension service, along with other innovative technical packages [57]. An interview with the former country programme manager for Rwanda confirmed that the policy engagement element of the project was very strong, and that the positive results obtained with bunding and hedge planting resulted in a policy change away from the previous labour- and resource-intensive terracing policy of the government.

262. In Viet Nam, no less than six innovative technical packages tested under an IFAD-financed project were officially recognized and included in the provincial public extension programme: these included the system of rice intensification, compacted fertilizers, high-quality rice varieties, improved compost, pig feed processed from cassava and the introduction of diversified fodder-grass species [59]. The latter refers mainly to elephant grass, which registered high levels of adoption by farmers and widespread diffusion (exceeding the target by 14 per cent).

Spontaneous adoption

263. **Spontaneous adoption was driven by a combination of different factors, including evidence of benefits to farmers, peer-to-peer learning, demonstrations and affordability.** Evidence was documented in six countries [7, 8, 16, 45, 48, 57] across Africa and Asia.

264. In Mozambique, the introduction of the use of ice on artisanal fishing boats appeared to have been spontaneously adopted more widely (presumably by fishermen who were not project beneficiaries), which was causally linked to the enhancement of the quality of the catch [16].

265. In the Democratic Republic of the Congo, the use of improved crop varieties spread to non-beneficiary farmers, by peer-to-peer learning. By the same token, following the installation of rice huskers by a project, many other farmers procured their own husking machines (with a dramatic increase of huskers from 5 to 300 in a five-year period in a single location alone), and many private entrepreneurs invested in rice processing and particularly husking; this was attributed to the large expansion of the rice production area driven by the project, as well as to the profitability of husking [7, 45]. Similarly, peer-to-peer learning was identified as a driver for scaling up innovations in Rwanda. Neighbouring farmers, even beyond the watershed borders, adopted several technical innovations introduced by the project within the first three years of project implementation (2006 to 2009), namely hedge planting of fodder crops on bunds for soil conservation, multiplication of crop seeds and improved cultivation and propagation of fodder grasses [57].

266. In Ethiopia, in some project locations, evidence was noted of improved technologies being spontaneously taken up by farmers in surrounding areas as a result of demonstration activities, with the potential to extend income and food security benefits to communities beyond the project [8].

267. In India [47], lightweight water pitchers and Napier grass production were both adopted beyond the original intended audience. The pitchers were demonstrated to 1,900 households and adopted by 12,000 households. Adoption of the pitchers was particularly enhanced by the farmer self-help groups and federations selling them on the market. The success of these innovations was attributed mainly to their low cost: Napier grass tufts were generally given away free of charge by households that had already established the grass, and the plastic pitcher was a popular cost-saving replacement for the commonly used metal pitcher.

Key points

- Replication was the most frequent way of disseminating innovations and was often assisted by grants. The case studies show that where innovations have worked, it is often where they are replicated in a succession of projects over a long period.
- In a few instances, missed opportunities were identified where promising technical innovations were neither replicated nor scaled up, seemingly because of loss of interest or the occurrence of new priorities.
- In a few cases, national extension programmes drove the innovations to the policy level.
- Spontaneous adoption took place in a number of cases and reaffirmed the viability of the innovations introduced. In many cases, the adoption was driven by peer-to-peer learning and demonstrations.

V. Emerging good practices and lessons learned

268. This ESR identifies a change typology with four parts: productivity enhancement, transformative change, asset strengthening and beneficiary health enhancement. The two most important changes were productivity-enhancing and transformative which made up 56 per cent and 28 per cent of the sample respectively.

269. The distinction between productivity-enhancing innovations and transformative innovations is important. Productivity-enhancing innovations are those that improve returns to land, labour and capital by means of incremental changes to the farm business, including forestry and fisheries. Transformative change, on the other hand, includes innovations that bring a major change to farming system structure and function by introducing new enterprises or radically different ways of farming and post-harvest technologies. Transformative innovations are considered higher-risk, and usually require broader packages of support to be successful.

270. The section below discusses selected productivity and transformative practices, using the typology developed for this synthesis and IFAD's model as explained in the ToC. Both types of practices are important to IFAD. However, each type requires specific accompanying support and involves different levels of risk and targeting.

Productivity-enhancing practices

271. **Introduction of fertilizer and pest management requires a package of support to work.** This includes enhanced efficiency of fertilizer use and the adoption of organic products, as well as tackling pests and weeds through integrated methods. Improved use of fertilizer and IPM/IWM bring quick and visible returns from lower costs or improved yields. A successful practice is to link field demonstrations with access to microcredit. A less common practice is to introduce applicator machines to overcome labour constraints.

272. **The SRI is beneficial to supporting innovations in rice production**. The SRI is not a fixed package, but rather a combination of practices, which are chosen to meet the needs of the context. The SRI may include the transplanting of seedlings, improved variety use, the use of compost and soil nutrient management, weed management and crop establishment. SRI has been popularized across three regions: APR, ESA and WCA.

273. **Introduction of improved or quality seeds requires a systemic and comprehensive approach.** Interventions must ensure that there is an appropriate framework for guaranteeing quality, continuity of partnership with research institutions to provide foundation material, arrangements for contracting or authorizing outgrowers, and a procedure for collection, grading and distribution.

Transformative practices

274. **The introduction of new crops helps to diversify production; however, it exposes farmers to new risks.** Diversification can benefit the family diet; however, more often, the aim is for cash crops to generate new income. In the latter case, links to processing and markets are critical. Being able to organize farmers and provide access to market information is critical for safeguarding farmers' interests and achieving an equitable relationship between farmers and buyers, in many cases.

275. **Improved use of water requires low-cost technology and materials that are readily available**. Drip and sprinkler irrigation improve efficiency; small-scale irrigation (SSI) with manual pumps and spate irrigation can transform crop options, as can water harvesting in microcatchments for fodder shrubs and fruit trees.

276. **Innovations for soil and water conservation and climate change adaptation are labour-intensive and generate little extra income; however, they can**

also reduce production costs and enhance food security. Introducing new plants and trees provides additional sources of grazing or fodder and can reduce soil erosion. Combined with nitrogen-fixing varieties and composting, they improve soil structure and fertility. Water harvesting and water infiltration can extend growing seasons and enable crop diversity.

277. **Alternative sources of energy have the potential to transform the household's energy efficiency and have significant health benefits, by reducing drudgery and smoke in the kitchens**. Biodigesters help dispose of waste products and reduce wood consumption. However, they present substantial limitations in terms of access to raw materials, demands on labour and a suitable climate; therefore, they are likely to be a niche technology, at best.

Lessons learned

278. **A collective set of technical innovations, such as SRI, provides a simple focus for project design**, even though the component parts can – and should – vary, according to local needs. Introducing collective sets of technical innovations for rainfed field crops, vegetables, livestock and others facilitates project design, implementation support and learning.

279. **Technical innovation to promote value chain development requires careful preparation.** Plans to add value by increasing production to create a marketable surplus, either through improved productivity or by transforming farm enterprises and processing, need to take account of markets: provision of inputs, sale outlets, buyer concentration, farmer negotiating power, and consumer demands, while avoiding overdependency. With new products, these can be hard to determine in advance.

280. **Environmental damage can arise from innovations supporting both diversification (new crops) and asset growth (livestock numbers), as well as productivity.** Productivity improvements can stimulate a more intensive use of inorganic fertilizers and pesticides, as well as overgrazing by livestock. Poorly planned water use brings the potential for salinization; and some types of processing, such as for cassava, generates effluent that must be controlled to prevent environmental damage.

281. **Effective partnerships are essential for input supply, technical advice, group development, dissemination and marketing.** Innovations can bring extensive demands for support from government agencies, research institutes, NGOs and private sector entities. Critical functions such as seed supply are difficult to establish. Negotiating shared objectives, resource availability, priority actions and supportive policies with partners all pose significant challenges.

282. **Managing successful innovation demands transdisciplinary skills.** Understanding the physical and social context, how best to engage and work with partners, the most effective mode of delivery, and how to organize participating farmers, all require skills that may outweigh the technical aspects of the innovation.

283. **The simpler the innovation, the greater the chance of it being sustained.** The most viable innovations are those that are low-cost and low-tech with short input supply and marketing chains, and that feature local manufacture and minimal maintenance. Some apparently simple technical innovations may be more complex to manage and sustain. Sustainability is less certain where government ownership is in doubt, partnership support is narrowly tied to projects, and technology is dependent on scientific support. Functioning local organizations and strong market connections all help sustain relationships and manage risks.

284. **Scale has to be considered when introducing innovations.** Some innovations only show their benefits when implemented at scale. Others, such as post-harvest and processing equipment and machinery, may be difficult to manage at scale.

VI. Conclusions and recommendations

A. Conclusions

285. **Technical innovation, defined as the introduction of a process or product that is new to the context, is mainstreamed in IFAD** and examples may be found in all aspects of the portfolio. According to this definition, the majority of project interventions are innovative. Most technical innovations aim to enhance productivity and offer low-cost, low-tech marginal improvements in cropping practice and animal health. They are classic interventions in agricultural development that entail low risk and are well suited to the needs of many farmers. Most innovations are of low technical complexity and are designed to bring incremental changes to the farm business.

286. **A smaller number of innovations are transformative.** Transformative innovations are more risky and carry a higher level of high-tech change. They can be more disruptive, with the potential for higher rewards; however, they require higher investments in terms of resources and knowledge. The distinction between productivity and transformation is important if IFAD wishes to promote substantial changes in income and food security. Innovations of a transformational nature are required to tackle the root causes of hunger and malnutrition within the Agenda 2030.

287. **The majority of technical innovations are not targeted to specific groups.** Most technical innovations are geared towards the "average" farming household in any location, that is neither very poor nor better-off. There are some exceptions for livestock and certain other innovations, which are more suitable for farmers with access to land and finance.

288. **Accompanying support and partnerships are essential for introducing innovations that require new knowledge and skills.** IFAD is well positioned to provide this type of support, as it is seen as a strength of IFAD's approach across the portfolio. IFAD usually has a facilitating role, linking the mode of dissemination, the implementing partners and the enabling environment. Grant-funded projects are the most frequently used mechanism for research and technical development; however, often they are not systematically linked with practical application and adaptation.

289. **Impact tends to derive from a package of innovation measures, and not from a single element.** Innovation is inherently uncertain. Some technologies take time to become established. These results may certainly reflect well on the projects; after all, income is a function of more factors than innovation alone. A positive impact on household incomes was found in only 20 per cent of all projects. A higher proportion (27 per cent) experienced improvements to food security and productivity.

290. **Many innovations related to agricultural practices are potentially significant for NRM and climate change mitigation; however, the associated risks must be carefully managed**. Some technical innovations had positive impacts on the environment, NRM and climate change aspects, such as drip irrigation and green manure; others may have unforeseen negative longer-term consequences, such as irrigation, cassava processing.

291. **IFAD deals with a highly diverse portfolio, with few repeat examples of many innovations.** A limited number of specific technical innovations were replicated in several locations. Otherwise, an extensive range of other innovations responds to local contexts and needs. The challenge to scaling up derives from the multiplicity and variety of innovations, such that there are few straightforward indications on which solutions are successful and for whom.

B. Recommendations

292. **Recommendation 1: Enhance focus on transformative practices within IFAD's approach to technical innovation, while continuing to promote low-risk improvements to productivity for the majority of poor smallholder farmers.** IFAD should recognize and reward innovative efforts that are transformational but, however, more risky. A working environment that rewards risk taking is at odds with a view that successful adoption is the only satisfactory outcome. A clearer distinction between the more routine productivity enhancements and the less common transformational innovations would help to understand and manage the change that is being promoted and better target the innovations. Some interventions evolve from being part of agriculture's natural cycle of learning and advancement towards a more transformative change. Project design would have to anticipate the point at which innovations become transformative and accordingly plan for dissemination and enabling support. Scaling up must be mainstreamed in project design, to maximize impact and returns to innovation.

293. **Recommendation 2: Systematically monitor, evaluate and learn from innovations.** Far too many innovations are underreported, which leads to learning being lost. This observation applies to both loans and grants. There is no systematic framework for evaluating innovation in project and country evaluations. Simple measures, such as using adoption rates in a uniform and consistent manner, can be very revealing. There is a need to address relatively simple questions about adoption rates, as well as why innovations did or did not work in the specific context. In addition, it is also necessary to provide better documentation when different packages of innovation work. Evaluation must understand the adoption and adaptation process, and how the enabling support functioned. More challenging innovations may benefit from a counterfactual model to demonstrate outcomes. A narrow focus on impact avoids the more practical questions on why an innovation works in certain settings, for some participants, and not in and for others.

294. **Recommendation 3: Use the forthcoming CLE to explore IFAD's readiness to promote transformative innovations.** This synthesis highlights the distinction between productivity enhancement and transformative change. A deeper exploration of the extent to which IFAD as an organization is set up to actively support transformative innovations should be undertaken by IOE. This would include an assessment of the risk culture prevailing in the organization.

Senior Independent Advisor's Report

Introduction

1. The terms of reference for this evaluation synthesis were to: (a) identify technical innovation practices and lessons learned about the potential for success and scaling up that can inform future IFAD interventions; and (b) identify key factors enabling (or hindering) innovation, within the limitations of the available evaluative evidence. Standard evaluation key questions were addressed, including relevance, effectiveness, impact, sustainability and scalability, as well as partnerships and specific IFAD criteria.

2. The Independent Adviser was requested to assess the soundness of the analysis, the key emerging issues and the recommendations of the evaluation synthesis. In particular, the main tasks of the Adviser were to: (i) review the draft final evaluation synthesis report and provide written comments and suggestions for improvements; and (ii) review the final evaluation synthesis report and prepare a brief report (as follows) commenting on the analytical framework, the structure and storyline, the description of context, the quality of analysis and the conclusions and recommendations.

3. For the better part of a century, the importance of innovation in economic growth has been recognized; and that of agricultural technical innovations (e.g. new crop varieties and livestock feeding practices) for agricultural and rural development. This recognition led to in-depth studies of technical and institutional innovations in agriculture, including their variety, complementarities, systems context, pathways to impacts and linkages to scaling. For more than two decades, IFAD strategies, plans and evaluations have emphasized innovation – and, more recently, scaling – in the project portfolio. Consequently, this evaluation synthesis of technical innovation is timely and will contribute to further internal assessments of innovation.

Analytical framework

4. The usual approach to synthesis was followed, namely: conducting a review of the literature and of relevant IFAD reports; performing a systematic screening of the evaluation reports to select a functional set for the synthesis, from which target innovation practices and a working typology were identified; and engaging in a comparative analysis of the innovation practices, including their assessment against IOE evaluation criteria (relevance, effectiveness, efficiency, impact and sustainability). The approach was complemented by case studies and interviews with IFAD staff.

5. The chosen time frame of 2010-2018 is appropriate. From the 106 products available over this time frame, 57 evaluations were selected. The composition of the evaluations is interesting: 25 country strategy and programme evaluations, 22 project performance evaluations/assessments, 3 impact evaluations, and 7 evaluation synthesis reports. Helpfully, more than 30 evaluations contain primary syntheses, notably, the country strategy evaluations and the evaluation syntheses – in this sense, this evaluation synthesis can be considered a metasynthesis. Unfortunately, only three impact evaluations could be included in this metasynthesis. Although the mixed composition of the sample products limits quantitative analysis, the assessments of this metasynthesis are underpinned by a wealth of evaluative evidence, which lends credibility to the conclusions and recommendations. Given the predominance of text in the evidence base, the choice of using the Nvivo software for analysis is endorsed.

6. One of the particular challenges in this evaluation synthesis is a practical definition of technical innovation. Many narratives surrounding agricultural innovation were founded on technical innovation, e.g. improved varieties, management practices or other research products, and developed further in relation to institutional

innovations. However, the interaction between technical and institutional innovation is frequently overlooked in the literature and in project design. This evaluation synthesis proposes a workable definition of technical innovation (box 1), while clearly recognizing the enabling role of many institutional innovations. The categories and examples of technical innovation presented in annex V (adapted from 3ie's experience) are adequate, although certain minor aspects could be improved, such as the separation of some related categories (e.g. seeds and crops) and the lack of attention to integrated technical innovations (e.g. crop-livestock integration). Unsurprisingly, of the 416 identified technical innovations grouped into 13 categories, approximately half comprised the crop type, crop management or livestock innovation categories.

7. The functional typology of technical innovations is generally acceptable (namely, productivity enhancement; transformative change; asset strengthening; and beneficiary health enhancement) and the exemplars in table 2 are useful and relevant to IFAD. Additional exemplars under the heading "Beneficiary health" would include pesticide spray practices, aflatoxin control in groundnuts and maize and disaster preparedness – as well as, perhaps, zero tillage cropping to reduce the labour burden of field preparation by women. However, it would be a mistake to place excessive weight on the typology, because of the interlinkages existing across the functional types and the phasing of farm development. For example, "incremental" productivity enhancement of staples is often an entry point to asset growth and "transformative" crop and livestock diversification (i.e. major changes to system structure and function). In addition, while history tends to record long-term successful development as "transformative", in project and short-term investment cycles on the ground, such changes are far more nuanced.

8. Highlights of the history and scope of thinking on innovation are reflected in the annex, although in no sense should this be considered a review of the abundant literature on technical innovations and innovation systems. Embedded in the annex on the ToC is an important classification of technical innovations: (a) "sole" or standalone technical innovation; (b) technical innovation supported by *essential* processes and institutional innovation for the effectiveness of the technical innovation; or (c) technical innovation associated with an *optional* complementary process and institutional innovation that magnifies or accelerates the impact of the technical innovation.

9. Another strength of the evaluation synthesis framework is the ToC. For the purposes of this evaluation synthesis, the theory neatly distinguishes technical innovations from enabling innovations in the context of investment projects, reflecting the phases of identification of scope, planning, dissemination and follow-up support. If the framework were to be further developed, for future studies based on broader terms of reference and more detailed data, there would be value in (a) unbundling the extension function to reflect public, private, NGO and farmer group actors and (b) recognizing that the adoption process includes elements of innovation trial, take up in fields, and adaptation to fit the farm household system (labour and cash availability and risk and consumption preferences), as farmers learn of the performance of the technology, and some disadoption or replacement by alternate technologies.

Structure and storyline

10. The structure is logical and sound. The overall storyline is relatively straightforward, although with some complexity in relation to the typical bundling, in many projects, of technical innovation with complementary enabling (often institutional) innovations – and the associated challenges in relation to attribution. The corporate context is detailed (and the timeline figure is compelling), and the analytical framework is appropriate and effective. The richness of the findings, albeit largely based on qualitative evaluative evidence, is striking – it is well structured by the evaluation research questions, and includes excellent cross-

referencing to the sources. The lessons are fairly compact, and have concentrated on the facts – in certain places, there are opportunities to draw out the implications for project design and implementation, recognizing the complexities of farming systems and institutional landscapes on the ground. The conclusions flow logically, and the conclusions and recommendations are strongly focused.

Context

11. The main body of the report focuses on the IFAD corporate context, supplemented by annexes III and IX. As noted elsewhere in these comments, innovation has attracted attention for almost one century and is a core theme of many public services and businesses. The fundamental role of agricultural technical innovation, whether done by research or by farmers, in agricultural and rural development and in poverty reduction is well recognized. The report contains a detailed account of IFAD policies, strategies and plans related to innovation and scaling, which provide the corporate context for this evaluation synthesis on technical innovation.

Quality of the analysis

12. The analysis is found in the rich chapter containing the "Synthesis findings" and in the brief chapter immediately following, titled "Emerging good practices and lessons learned". The analysis is certainly sound and of value to IFAD Management. In fact, the team has extracted several relevant findings and lessons, given the challenges of the focus on technical innovation alone and the practical limitations posed by the availability and quality of evaluative data. IFAD may draw significant lessons relating to the quality of the underlying evaluative data, and not only in relation to M&E and reporting; however, the increased attention for social and institutional innovations (as compared to technical innovations) in recent IFAD policy, while understandable and appropriate, may have distracted project management and evaluations from ensuring clarity in reporting the underlying technical innovations. Some particular themes worth further exploration in follow-up studies are discussed briefly in the next paragraphs.

13. Underdevelopment is characterized by the scarcity of technical knowledge, in a context of weak institutions and governance. While the separate implementation of technical or institutional innovations may occasionally be successful, a majority of smallholder agricultural development projects require specific bundles or combinations of synergistic technical and institutional innovation at each stage of implementation, from diagnosis to follow-up scaling, to generate the best rates of return. A simple example would be the contrast between improved varieties of open pollinated legume crops and the complementary institutional innovations for community seed multiplication, quality and distribution; and hybrid maize seed and the institutional innovations for seed multiplication, marketing and financing by the private sector. Systematic project review and adaptive management naturally foster appropriate adjustments during project life. Direct investment in capacity for local innovation systems also generates high pay-offs, through the ongoing generation of new innovations – including of a technical nature – in project areas.

14. The inclusion of marginalized groups, notably youth, and gender empowerment are essential themes in modern sustainable rural development. It is surprising that the evaluation evidence lacked sound information on these aspects. Clearly, improved stoves and water management had a direct (positive) impact on women; however, it is likely that poor rural women also benefitted significantly from many crop type, crop management and livestock innovations. However, data were scarce and the evidence was thin. Similarly, the lack of information on the participation of and impact on youth is surprising.

15. In development discourses today, the term "sustainability" is used with two completely different meanings. In this evaluation synthesis and in certain research organizations, the term indicates the continued use of the technical innovation by the target population. However, the more common meaning, deriving from the

Bruntland report and the United Nations Conference on Environment and Development (the Rio Summit), is the stability and continuation of socioecologic systems, with economic, environmental and social indicators, after the technical innovation is adopted. In relation to the latter (broader) meaning, the synthesis could have placed more emphasis on the contrast, and often conflict, between intensification and livelihood improvement on one hand, and environmental outcomes and sustainability on the other. The negative trade-offs between economic development and the environment have been emphasized by many United Nations and national strategic documents. Nevertheless, recent (impressive) gains in household food security and poverty reduction have been achieved at a significant cost to underlying agricultural resources, namely aquifers, soil health and agrobiodiversity.

16. The resilience of the farm household systems of the poor is of critical relevance to enduring rural poverty reduction, and could have been discussed in greater depth. Increased resilience is required with particular reference to climate variability and market volatility, as well as to the risk of a slide back into poverty (e.g. from ill health, droughts, price collapses). An important aspect is foresight knowledge, including scenarios of climatic, economic and industry conditions.

17. The selection and management of partnerships is central to the effectiveness, impact, sustainability and scalability of technical innovations – with wider relevance than training. The key issues are not only sectoral balance (research or business), but also the selection of individual partners with appropriate human and financial capacity, aligned objectives and the trust of communities. It could be argued that IFAD plays an important role as a broker as well as an *entrepreneur* in partnership formation and management – and success in these aspects underpins the effectiveness, impact and scalability of technical innovations. The selection of partners also determines the plausible pathways to impact for technical innovations (such as the private sector or public extension) and, in this regard, the best modality and the likelihood of success of scaling.

Conclusions and recommendations

18. The evaluation synthesis conclusions and recommendations are relevant and important, and are supported by the evidence and analysis found especially in the rich synthesis of findings and in the brief lessons learned chapters.

19. The ten conclusions on technical innovation in IFAD projects are valid and are supported by the evaluative evidence. The mainstreaming of innovation, and in particular technical innovation, in IFAD is a major achievement. To a large degree, the diversity of the 416 technical innovations across 13 categories (with crop types, crop management and livestock accounting for half of all innovations) simply reflects a "demand-driven" approach, which in turn echoes the varied needs of farmers in different farming systems and institutional contexts across the 80 countries considered in this study – and, as such, the diversity of technical innovations is not an issue in itself. Fostering the local adaptation of technical innovations through functional research linkages could add value to the dissemination and scaling aspects of many projects. The evidence that productivity-enhancing technical innovations (low-complexity, low-risk, adoptable by a spectrum of farm types) reduce poverty in many different farming systems should be viewed as an IFAD success (reflecting "IFAD's strengths and purpose"). Moreover, enhancing the productivity of existing farm enterprises frequently leads to diversification, i.e. transformation. Indeed, the productivity enhancement of staples to ensure household food security is often a precondition for effective diversification and transformation. Therefore, there is a phasing opportunity, for initial investments on productivity enhancement, to be followed by transformative technical innovations in subsequent investment streams. Clearly, the limited impact on gender empowerment (except for stoves and water), natural resource management (except for soil and water conservation) and climate resilience is a

matter of some concern (as is youth) and merits further investigation in an integrated technical and institutional innovation context. Overall, this analysis shows that IFAD faces the risk of successful productivity enhancement (intensification) and transformation (diversification) being achieved at a significant cost to the environment (see remarks above). Another significant conclusion from the evidence is the effectiveness of combined technical innovations, pointing to the importance of integration in design and implementation. The unevenness of monitoring and evaluation (M&E) data is clear from the analysis. The lack of attention paid during the design stage to foresight and scaling is also a concern.

20. Recommendation 1 on "enhancing" transformative practices (while continuing to promote low-risk innovations for productivity enhancement) is endorsed on the understanding that the proposed "enhancement" of transformative practices recognizes the *synergies and sequencing between farming systems productivity enhancement (intensification) and transformation (diversification)*. Moreover, the synergies between different types of technical innovations for transformation (e.g. crop-livestock integration) must be better understood and incorporated into investment designs for transformation.

21. Recommendation 2 on systematically monitoring, evaluating and learning is fully supported. High pay-offs to investment in stronger monitoring, learning and evaluation would be expected not only for future evaluations, but also to strengthen the adaptive management of project implementation. It could be added that the scope of the monitoring and learning should include the *pathways to impact*, beyond the technical innovations, adoption and outcomes alone; and embrace the economic, environmental and social spheres of *sustainability*. Moreover, stronger focuses on inclusivity (especially with regard to gender), sustainable resource management and climate resilience would be advantageous. The management of risk at all levels (technical innovations, farm management, project implementation, corporate management) merits attention.

22. Recommendation 3 is clear – the planned CLE would clearly benefit greatly from the well-documented evidence base and the analysis of this evaluation synthesis. The findings of the evaluation synthesis suggest that close examination is required of six critical themes relating to innovation in the IFAD portfolio: inclusivity (including gender and youth); linkage of low-risk productivity enhancements (intensification) with farming system transformation (diversification); integration (of technical and institutional innovations, and of farming system components); sustainable resource management (avoiding environmental costs); dynamics (of farm and rural development); and risk management, at all stages of the project cycle.

Summary

23. In summary, given the narrow focus on innovations of a technical nature and the limited availability of quantitative evaluative data at project level, the team has conducted an excellent analysis and has identified important lessons for IFAD and its partners. The evaluation synthesis benefitted from a good range of existing evaluative products. The report also constitutes a solid foundation for follow-up studies on innovation in agricultural and rural development in general, and in the IFAD project portfolio in particular.

Case studies

COUNTRY	India
PROJECT NAME	Livelihoods Improvement Project in the Himalayas
IMPLEMENTATION PERIOD	2003-2013
PROJECT TYPE	Credit and financial services

1. **Context.** Over the last decade, India has experienced rapid growth, joining the ranks of middle-income countries in 2007. However, one third of the world's poor continue to live in India, where pockets of deep poverty have formed because of uneven growth across the country. Population growth has further increased the pressure on natural resources to meet the domestic and global demand for food. In this context, the Indian agricultural sector shows resilience to natural shocks and market volatility, including as a result of favourable investments and technological uptake. Over recent years, leveraging technology has been a key driver of sustainable agriculture in the country: according to the Global Innovation Index (2017), India has consistently outperformed on innovation relative to its gross domestic product (GDP) per capita.

2. With the objective of achieving sustainable and inclusive agricultural growth, India is currently supporting innovation through policy support and institutional development. India's current public policy with regard to agriculture is focused on encouraging innovation and entrepreneurship, thereby fostering the growth of an ecosystem for technology and digital innovation. This process aims to provide access to new technologies for farmers, with a focus on the marginalized rural poor, who are targeted by national development schemes.

3. **Project.** The Livelihood Improvement Project for the Himalayas was designed to target vulnerable groups in the Himalayan region. Population growth in an area dependent on subsistence agriculture weakened the self-sufficient system of mountain communities, resulting in the depletion of natural resources and unsustainable farming systems. Moreover, traditional practices usually performed by women and older people were gradually abandoned, as agricultural tasks required an increased number of labourers.

4. The primary objective of the project was to improve the livelihoods of vulnerable groups in a sustainable fashion through the promotion of livelihoods opportunities and the strengthening of concerned institutions. The project was implemented in five districts of the states of Meghalaya and Uttarakhand. The main target consisted of groups that fell either below or just above the poverty line, reaching approximately 72,000 households in over 1,730 villages.

5. The two states where implementation took place, Meghalaya and Uttarakhand, present highly different environmental and sociocultural conditions. Uttarakhand, located in the western Himalayas, is mostly covered by hills and mountains, which leaves limited space for agriculture. However, 80 per cent of the hill population relies on rainfed agriculture for its livelihood. The monsoon climate further increases soil erosion and degradation, affecting overall productivity. The State of Meghalaya, on the contrary, is situated on a vast plateau in the eastern Himalaya. Approximately 80 per cent of the largely tribal population depends on agriculture, which is mainly performed by women, with limited use of modern techniques and low productivity. A large portion of the cultivated area is under "shifting cultivation" (*jhum*) for the production of horticulture crops and spices, which are then marketed in the plains or in the neighbouring region of Assam.

6. **Innovation.** Several innovations were introduced in Meghalaya and Uttarakhand: solar lanterns, improved stoves, SRI, polyhouse cultivation, *jhum* system improvements, organic production, Napier grass, vermicomposting, motorized wheat threshers, power tillers and chaff cutters, ergonomically designed agricultural tools, fibre weaving from nettles, organic repellents, and lightweight pitchers for drinking water collection.

7. The use of ICT further enabled technical innovations: the 2015 India CPE witnessed instances of ICT use in the Uttarakhand segment, fostering the creation of a web-based "federation helpline" for women's self-help groups (SHGs) on federation governance issues. All communication materials were uploaded onto Google Docs and used by the project staff to share and analyse the work; SMS-based communications were exchanged between SHGs on cultivation techniques, climate, market rates of various crops, and government schemes, in collaboration with the Department of Telecommunication.

8. Detailed information is available on a limited number of initiatives:

   a) Organic production practices (adoption[1]);
   b) Napier grass (adoption);
   c) Vermicomposting (adoption);
   d) Lightweight pitchers (adaptation of metal water pitchers);
   e) Solar lanterns (adoption).

9. **Identification.** Technical innovations have been identified within the three main areas of intervention and innovation presented in the 2001 COSOP for India. These include promoting women's empowerment and representation in local government bodies, access to common property resources and natural resource management, and non-farm enterprise development. The 2001 COSOP further recognized the establishment of SHGs as platforms for poverty reduction and development. The SHGs would be the recipients of new technologies, made available in a number of different sectors, thus further contributing to capitalizing on the time saved by women and enabling their empowerment.

10. **Pre-inception report.** For Meghalaya, technical innovations were mainly directed at introducing new farming practices and crop varieties, supported by extensive training and people mobilization. The need for this intervention stemmed from the widespread employment of *jhum* practices – which are responsible for soil degradation – in the region, as observed during a pre-inception study and field mission. The need to support natural resource management in tribal areas was also included in the 2001 COSOP as a primary area of intervention.

11. **Strategy.** While the innovations implemented did not require complementary inputs in terms of increased resources, they were strongly complemented by various empowerment and extension activities. This is especially true for farmers following the "shifting cultivation" method, experienced soil depletion and pest infestation, and were trained in vermicomposting and other IPM practices. The formation of SHGs and cluster-level federations, supported by the project, further enabled the adoption and diffusion of innovative technologies (e.g. solar lanterns and Napier grass) through the organization of demonstrations and increased access to credit.

12. **Adoption.** Adoption was encouraged by the local context. Solar lanterns, for example, provided a solution to the erratic supply of electricity in Uttarakhand. Their adoption allowed local families to save on the cost of electricity and kerosene, while providing them with good-intensity light.

[1] The nature of the innovations varied, including adoption from another setting, adaptation of an already existing technology and also the creation of new elements.

13. The introduction of technical innovations encountered several barriers. The Meghalaya Joint Review Report reported constraints on the implementation of organic production techniques in Tehri District, including constraints relating to the availability of inputs at village level; a lack of fodder to sustain cattle for milk and produce the manure required for organic farming; the distribution of free chemical fertilizers and pesticides by the Department of Agriculture and the consequent cross-contamination of organic plots; a lack of knowledge on the organic certification process; a lack of training facilities near villages; and a lack of grading, packing and transportation.

14. The introduction of Napier grass was constrained by the initial reluctance of beneficiaries: villagers believed that local grasses were more suitable for their cattle and that Napier grass would have reduced milk yields. Moreover, they were convinced that Napier grass would have taken a long time to grow, representing an additional burden for the households.

15. **Diffusion.** The project was successful in introducing new drudgery-reduction tools and practices. Napier grass achieved the highest level of adoption (151 per cent), followed by vermicomposting (49 per cent). However, the choice of implementing the project in two non-contiguous states may have limited the opportunities for cross-learning and technical transfer.

16. A number of technical innovations were not adopted, because of either high start-up costs or insufficient returns on investment. Insufficient technical support was also among the main reasons for the limited uptake. Given the low replication rates, demonstrations were considered an ineffective mechanism for introducing sustainable technologies. In Uttarakhand especially, multiple demonstrations in the same villages were not efficient and the replication of demonstrations yielded results that were less than satisfactory.

17. **Poverty relevance.** The introduction of innovative production methods, tools and crops, complemented by household drudgery-reduction initiatives, significantly reduced women's workload and time poverty. Solar lanterns, introduced to provide poor households with a stable source of energy, proved to be both cost-effective and pro-poor. In addition, the fact that poverty was prevalent among those households that were dependent on *jhum* and facing increasing marginalization because of the continuous decline in *jhum* yields suggests that the programme efforts for improving "shifting cultivation" methods were relevant to poverty reduction.

18. In Uttarakhand, certain SHGs turned the new technologies into a business opportunity, benefitting other women as well. This was the case with water pitchers and solar lanterns, which reduced the time and energy spent on household chores; they were also promoted and sold by SHGs to other women in the area. Likewise, the labelling and organic certification, for example, were highly relevant, as they transformed traditional crops or medicinal plants produced for self-consumption to be sold to the local markets, in important income-generating activities.

19. Despite the project's efforts to engage the poorest households, the project failed to include the poorest rural groups in Uttarakhand, who were underrepresented in the SHGs. In Meghalaya, the primary target group were marginalized women and rural households; therefore, the poorest and mid-poor strata of the population were prioritized. However, during the implementation phase, the focus shifted towards better-off households, of which 91 per cent had been covered. The poorer categories had a limited coverage of 32 and 35 per cent.

20. **Cost-effectiveness.** Relying on solar power, the adoption of solar lanterns provided households with more light than electricity and kerosene. Lanterns were also cheaper to operate than traditional energy sources and than more complicated solar home systems, which were affordable only for well-off households. Napier

grass cultivation was introduced as fodder; the crop had no cost attached, required little water and its tufts were given away for free by households with an established cultivation.

21. **Outcomes.** The primary outcomes of the technical innovations presented above were improved productivity in terms of increased yield and incomes, as well as increased household gender equality and women's empowerment. According to the Annual Outcome Survey carried out in 2011, 60 per cent of project group members reported increased crop yields, compared to only 25 per cent in the control group. There was a significant positive change in the use of improved agricultural inputs, such as seeds, organic pesticides and fertilizers, and new crop varieties, as well as evidence of improved agricultural practices. Paddy cultivation using the SRI technique significantly raised the productivity of rice in Meghalaya.

22. The adoption of improved methods for organic crop production, including soil and water conservation and appropriate pest control techniques, substantially contributed to increased yields: up to double, in some cases. Improved income is also attributable to the introduction of small polyhouses, where seedlings and off-season vegetables were produced and marketed by the federations.

23. **Time saving.** The reduction of the domestic workload allowed women to engage in other activities and build their social capital. The employment of motorized wheat threshers reduced the threshing time by 96 per cent, Napier grass production reduced the time spent by women in collecting fodder by 60 per cent and the lightweight water pitcher reduced water collection time by 30 per cent. As a result, the overall time spent by women on household chores was reduced by five hours a day.

24. **Sustainability.** Provided that repairs and maintenance can be done locally, the labour-saving technologies and their enabling effect on women's empowerment are likely to be sustainable. Despite their inefficiency, the demonstrations are likely to have influenced people to a certain extent, as trainers and lead farmers will continue to serve the communities over the long term. Their services have also started to be compensated with a fee, which further enhances the sustainability of the system, thereby benefitting both the local area and the dissemination process. However, the relatively low level of replication of the demonstrations and the limited support offered by financial institutions hampers the sustainability of skills and knowledge transfer in certain locations.

25. **Scaling up.** A number of initiatives introduced by the project were spontaneously adopted beyond the project's premises. The main example was the lightweight water pitcher, which was demonstrated to 1,900 households and adopted by 12,000 households. SHGs and federations further enhanced its adoption by selling the pitcher on the market. Napier grass was another innovation that exceeded expectations and reached beyond the intended audience. The reason for the success of Napier grass and the lightweight pitcher is attributable to their low cost.

26. Other technologies often required additional investment, and with few income-earning opportunities for women, the opportunity cost of their time was virtually zero. Therefore, even if a considerable amount of time was saved, households placed almost no value on women's time and were therefore unwilling to invest in labour-saving tools. As a result, the following interventions were not so widely adopted, although they were sometimes popular in specific places: smokeless stoves (as bottled gas and, more recently, electricity have become more popular for cooking), chaff cutters (human-powered; an electric version would reduce the work required), cattle troughs (expensive but popular in some places), and farm equipment, such as threshers and ploughs.

COUNTRY	Brazil
PROJECT NAME	Rural Communities Development Project in the Poorest Areas of the State of Bahia
IMPLEMENTATION PERIOD	2006-2014
PROJECT TYPE	Rural development

27. **Context.** Brazil is the largest country in South America, with a population of approximately 209.3 million in 2017.[2] The World Bank classifies Brazil as an upper-middle income country with a gross national income of US$8,580 per capita.[3]

28. Compared to other developing countries, Brazil has a relatively well-developed innovation system, with several universities placing well in the world rankings and a growing role in world knowledge production. Policies and institutions play a key role in supporting this process. In the past, the agricultural sector in Brazil benefitted from successful policies aimed at enhancing the country's innovation system. As a result, the country established a broad research and development system, comprising a diverse set of institutions, with the advantage of having close relationships with farmers. This allowed Brazilian agriculture to benefit from a wide range of technological innovations in the fields of genetic engineering, soil improvement and correction, plant and animal breeding, livestock technologies, and more.

29. Despite the innovative component of its agricultural sector, Brazil presents high levels of income inequality and poverty, with a higher prevalence in rural areas.[4]

30. **Project.** The Rural Communities Development Project in the Poorest Areas of the State of Bahia, also known as *Gente de Valor*, targeted 29 municipalities in the semi-arid zones in the northeast Brazil. This semi-arid area is commonly known as the Sertão. It is characterized by stunted and sparse vegetation, which constitutes the *caatinga* biome. The project's development goal was to reduce poverty, especially extreme poverty levels, among the semi-arid communities of the State of Bahia.

31. **Innovation.** The project introduced 13 technical innovations, clustered into three main categories. Agricultural and livestock-related innovations included the implementation of agroecological techniques, water-saving productive home gardens, soil conservation practices (mixed cropping), improved management of small ruminants in *fundo de pasto,* and apiculture. Processing innovations included desalinization plants in Brazil plum processing units, equipment for fodder processing, innovative harvesting techniques aimed at reducing tree damage, sisal manufacturing, and processing plants for Brazil plum, ouricoury palm, cassava and honey. Environmentally sustainable techniques included plantation of native tree seedlings for conservation, sustainable extractive practices, eco-efficient stoves and biodigesters.

32. Detailed information is available on productive home gardens, agroecological practices, processing plants, eco-stoves and biodigesters.

33. **Identification.** *Gente de Valor* was conceived as a consolidation of a previous IFAD-funded project in Brazil, the Community Development Project for the Rio Gavião Region, or PROGAVIAO. The main aim was to expand PROGAVIAO's

[2] World Bank Databank: https://data.worldbank.org/indicator/SI.POV.DDAY?locations=BR.
[3] World Bank Databank: https://data.worldbank.org/indicator/SI.POV.DDAY?locations=BR.
[4] UNDP MDG Country Report, Brazil 2014: http://www.undp.org/content/dam/undp/library/MDG/english/MDG%20Country%20Reports/Brazil/140523_relatorioodm.pdf.

approach to other municipalities in the State of Bahia, characterized by similar baseline conditions to those of the previous intervention. The terminal evaluation mission for the PROGAVIAO project highlighted the project's strategy in addressing critical infrastructure issues that have a key impact on rural development and livelihoods. An example is ensuring water security for residents and livestock, an issue addressed by *Gente de Valor* through the establishment of water-saving productive home gardens.

34. The introduction of bio-digesters and eco-efficient stoves, aimed at reducing energy consumption relying on the use of firewood and manure, was finalized only after the MTR. It was included in the project through a grant, which was initially intended to support castor bean production and transformation.

35. **Strategy.** The majority of innovations, aimed at supporting productive activities, required the construction of infrastructure that allowed for increased access to water, as scarcity of water was a structural condition of the area of intervention, the semi-arid Sertão region.

36. In 2008, as one of its first activities, the project started to build water tanks (for human consumption and horticultural production), as well as water reservoirs for livestock consumption. This allowed for the subsequent implementation of productive home gardens and agroecological trials. The project also recovered eight dams and built one. The stored water was destined for animal consumption, fish farming and irrigation of small vegetable plots.

37. One of the components of *Gente de Valor* was devoted to the development of human and social capital in the targeted communities. The project offered training and support in organizational, managerial and technical capacities, combined with a dedicated strategy to include women and young people. This enabled the adoption and diffusion of innovations in the productive component. The creation of groups of interest (GIs), small subgroups with a stated interest in a specific priority action, supported the definition of intervention projects promoted by *Gente de Valor*. GIs also supported the adoption and diffusion of several technical innovations, such as productive home gardens, agroecological techniques, apiculture, fruit and cassava processing, nurseries, eco-stoves and biodigesters. Processing represented a major part of the GIs (16 per cent of the total): processing of fruit (usually native species, such as Brazil plum, ouricoury palm and cashew) and, to a lesser extent, the processing of cassava constituted one of the beneficiaries' main priorities.

38. **Adoption.** A package of agroecological techniques was tested on dedicated plots. However, the implementation and management of these trials revealed difficulties: these trials mainly followed a standardized format, which reduced their experimentation potential. The stated objective of this intervention was to compare traditional practices and new practices testing different varieties, fertilizers, spacing, and production costs. However, in the plots visited by the MTR team, several agroecological practices had not been used, including the association of crops and the use of local organic matter. Also, the physical management aspects of the soil were not worked[5].

39. In the case of cassava, the project financed plot preparation and fencing. It also provided different local varieties from other regions and from the Brazilian Agricultural Research Corporation. However, in the plots visited by the mission team, it was observed that manioc was the only cultivation, with the soil being completely uncovered and employing an imported non-synthetic fertilizer, at a relatively high cost.

40. Several varieties of forage plants were experimented with (sweet and giant palm, sorghum, *mandacaru* without spines, *leucena*, forage watermelon), using several

[5] It should be noted that this is only relative to the gardens visited by the MTR mission team, whereas there are examples of more successful organic trials (IFAD. 2010. Gente de Valor Mid-term Review. p. 45).

techniques (e.g. spacing or fertilization). The objective of these trials was to monitor the yield, its adaptation and the attendant costs, in view of their future employment as fodder. This represented a possibility for improving the rearing of small animals (mainly sheep and goats) and cattle for milk production. Given that animal husbandry is a source of savings and income in the region, the farmers showed great interest in these trials.

41. Adoption was fostered by the context-relevance of the innovations promoted. Droughts are cyclical events affecting local production and soil conditions, and are mitigated by conservation practices implemented by *Gente de Valor*. However, the adoption of a number of innovations was constrained by several factors. The processing plants for cassava, Brazil plum and honey required sanitary and environmental authorizations, which were indispensable before their construction could commence. The release of these concessions delayed the completion of the physical works, as well as of all of the activities required for the proper functioning of these units. Delays in the delivery of eco-efficient stoves were also reported.

42. Access to land also represented a barrier to the implementation of productive home gardens. According to the Register of Domiciles and the Cadastre of Rural Property, 41.7 per cent of the 693 surveyed properties were smaller than five ha; of these, 23.2 per cent were smaller than two ha. In a semi-arid environment, this amount of land provides only limited support to the livelihoods of rural families. In the case of certain suburbs targeted by the project, some beneficiaries did not have enough land to build a cistern. The associations also encountered difficulties in finding a suitable area for the nurseries.

43. **Diffusion.** According to the PCR, 6,245 farmers adopted the water cisterns for water storage. As for productive home gardens, 4,893 farmers benefitted, introducing their produce into their diets. Twenty-two productive units were implemented over the course of the project. However, the construction of cassava processing units was very expensive. As a result, the project could not meet the demand for processing units, which resulted in limited uptake of the innovation. In some cases, this further affected the planting of cassava, which diminished because of a lack of accessible processing units.

44. **Poverty relevance.** There is clear evidence that the project works with the poorest. There is no questioning of its success in this prioritization. This is particularly relevant, as policies and projects to combat poverty often struggle to reach this segment, which generally does not have structured forms of organization and is difficult to identify and access for planners and managers. In addition, the fact that the innovations were well adapted to the local conditions reinforces their poverty relevance. Specifically, ouricoury palm processing machines were relatively small in size and entailed low costs, and could be easily taken from family to family, towed by a motorcycle. Apiculture only required a small investment and a relatively small amount of individual labour to generate income, which made it a pro-poor intervention.

45. **Cost-effectiveness.** Productive home gardens appeared to have high benefit/cost ratios. Productive home gardens rely on two 5,000 l cisterns for irrigation. The relatively small size of the cistern, a cost-saving feature, enabled a significant number of households to be served. However, it did not allow for the irrigation of important areas of vegetables (smaller than 50 m^2), even when combined with water-saving cultivation techniques. Therefore, the MTR reported that the produce from the productive gardens was mainly destined for self-consumption. As for the rearing of small ruminants, the costs of introducing improved raising practices for a herd of 30 heads is estimated at 2,094 Brazilian real (US$687) per household on average, while annual net profits increased from US$981 to US$3,267, meaning that within one year of operations, costs could be recovered and exceeded. Apiculture and ouricoury processing machines were indicated as cost-effective.

46. **Outcomes.** The principal ways in which the innovations bore impact were increased household assets in terms of consumption (increased food security), increased knowledge and behaviour, and resilient environmental and natural resource sustainability.

47. Soil conservation and water-saving practices had an impact on the sustainability of the local ecosystem, further strengthening the resilience of family production establishments. Productive home gardens enhanced availability and diversity in the household food basket by adding new types of vegetables (e.g. lettuce, beetroot, cabbage, onion) and fruits (e.g. orange, lemon, mango). Communities assisted by the project reported a better availability of fruits and vegetables in their diet, either through consumption of their own produce or because small earnings from the home gardens were used to purchase higher-quality food. Product diversification was also achieved through the cultivation of seedlings within nurseries, which were then sold in the neighbouring communities, allowing the beneficiaries to strengthen production, preserve biodiversity and raise their incomes.

48. The involvement of women in home gardens and, through that, in vegetable farming, fruit and cassava processing and handicrafts allowed them to access and have control over part of the household income for the first time. They were also involved in beekeeping and goat raising, which were previously considered responsibilities of men. The project adapted certain investments to women's needs, including the construction of potable water tanks close to their houses and the introduction of eco-efficient stoves and biodigesters for drudgery reduction.

49. **Sustainability.** The initiatives conducted in the focus area on selected value chains were implemented in the last phase of the project. Their sustainability depends on the continuity of follow-up work and investments. Productive home gardens and ecological techniques introduced important changes in the form of resource use by families, with positive impacts on physical and financial health that are likely to be sustainable. While these initiatives showed good chances of economic viability, they still required financial support and technical assistance for consolidation to produce a significant increase in income per family.

50. The sustainability of ouricoury *coquinho*-breaking machines is supported by the local availability of inputs and repair services.

51. **Scaling up.** The Government of Bahia provided support to the project's activities from the very beginning. The State's Government showed great interest in the innovations and approach introduced by *Gente de Valor* and their potential to be upscaled to other municipalities of the State of Bahia. However, the lack of adequate monitoring, systematization and documentation of such innovations and best practices hampered scaling up, as well as the possible contribution to public policies and programmes.

52. **Lessons.** Adaptation to the local context and the support provided to enabling factors were key elements of the innovations promoted.

53. The poorest groups are often hard to reach, as they are usually spread across large areas and lack any structured organization. The creation of associations and GIs allowed the project to empower these groups and foster the adoption of innovations targeted to the poorest individuals.

54. The specific agroecologic conditions of the area of intervention, the semi-arid Sertão, required preliminary initiatives aimed at ensuring water access. Innovations could therefore be implemented through this previous preparation work.

COUNTRY	Rwanda
PROJECT NAME	Support Project for the Strategic Plan for the Transformation of Agriculture
IMPLEMENTATION PERIOD	2006-2013
PROJECT TYPE	Agricultural development

55. **Context.** Rwanda is a landlocked country located in sub-Saharan Africa, with a growing population of approximately 12 million in 2016[6] and the highest population density of the continent. Over the last 15 years, the country's economy has continued to grow at a sustained pace, fostering poverty reduction: from 59 per cent in 2001 to 39 per cent in 2014.[7] At the same time, Rwanda reported an outstanding record as an innovation achiever, figuring among the six sub-Saharan economies listed as innovation achievers at least five times in the past six years.

56. The agricultural sector continues to be a key component of the country's economy, contributing to 30.9 per cent of the total GDP in 2017. However, Rwandan agriculture is mainly characterized by small production units, reflecting the issue of land availability and the relative pressure exerted by the growing population on the country's national resources. Poverty continues to prevail in rural areas (43 per cent), especially among households with limited landholding, which obtain more than half of their income from working on other people's farms (76 per cent).

57. **Project.** The Support Project for the Strategic Plan for the Transformation of Agriculture (PAPSTA) was initiated in 2005, with the overall objective to "contribute to the poverty reduction process in Rwanda by providing concentrated and collaborative implementation support to the PSTA, which aims to transform the current practice of subsistence farming into market-oriented agriculture, increasing opportunities for growing cash crops, while ensuring food security and preserving the existing resource base".

58. The project targeted the poorest segment of the rural population, focusing specifically on women-headed households, youth, families affected by HIV and civil war. It further aimed at covering the broader needs of farmers' associations and their federations, as well as the administrative and coordinating central, provincial and district bodies in charge of agriculture and the implementation of local development plans.

59. **Innovation.** PAPSTA was designed with two technical components. The first component was dedicated to building institutional support, fostering capacity-building in the agricultural sector and strengthening rural community organizations. The second component of the project aimed at improving agricultural and livestock production through specific pilot actions, articulated in five subcomponents:

- Watershed protection and hedging (piloting soil and water conservation practices);
- Integration of livestock into agricultural systems (introduction of high-quality breed livestock);
- Marshland development and rice production (system of rice improvement, or SRI);
- Research and development to support agricultural intensification (improved rice varieties and soil conservation practices);
- Replication mechanisms for pilot actions (mainly of a financial nature).[8]

[6] World Bank data. Available at: https://data.worldbank.org/country/rwanda
[7] Ibid.
[8] IFAD, *Report and Recommendation of the President* (Rome: IFAD, 2005), p. 7.

60. Eight technical innovations were identified: hedge planting of fodder trees and grasses on bunds for soil conservation (*bocage)*, optimal use of organic manure in combination with fertilizers or lime and natural phosphate to improve paddy soil fertility, rainwater harvesting for hillside small-scale irrigation, new rice varieties, seed multiplication (corn, bean, soybean, potato, manioc), SRI, introduction of high-quality breed livestock, biogas digesters.

61. Detailed information is available on the new technologies for soil protection, specifically the system of *bocage* (hedging), the introduction of SRI, the genetic improvement of livestock through artificial insemination and seed multiplication.

62. **Identification.** IFAD's strategy in Rwanda, as documented in the 2007 COSOP, builds fully upon government strategies for the transformation of the agricultural sector.

63. The main policy of reference was the national Strategic Plan for the Transformation of Agriculture (PSTA), a component of Rwanda's policy for poverty eradication, which emphasized poverty reduction, devolution of power to decentralized administration, empowerment and capacity-building at all levels. The PSTA provided the basis for selecting the technical innovations introduced by PAPSTA. This project was designed collectively by different stakeholders (donors, beneficiaries, government) with the aim of supporting the Ministry of Agriculture in managing and implementing the four priority action programmes of the PSTA.

64. **Strategy.** The introduction of innovations often required the provision of complementary services. The distribution of pure-breed and cross-breed cows, as well as the replacement of local cows with artificial insemination, required the establishment of a professional veterinary system. The project design envisioned the creation of a private veterinary system at the district level, supplying medicines for the prevention and control of livestock disease. The veterinary system had an animal health insurance scheme attached. The scheme followed a basic principle, requesting the payment of 1,000-2,000 Rwandan francs per farmer to constitute the initial fund from which the cooperative reimbursed 50 per cent of the veterinary costs incurred by contributing farmers.[9] During the second phase of the project, together with a pregnant heifer, beneficiaries were provided with a batch of acaricide products to administer preventive treatments against tick-borne diseases.

65. Since its pilot phase, SRI reported increased incomes. However, to achieve its full potential, SRI required a specific technological package. Specific mention is made of the water management component. Seed multiplication required complementary inputs in terms of manure and phytosanitary products, for which sale counters were established.

66. **Community-level capacity building.** The replication of successful innovations was enabled by strong institutional support, established in component 1 of PAPSTA. The activities under this component were intended to build the capacity of decentralized stakeholders to implement project activities and share the knowledge required to replicate pilot actions.

67. PAPSTA established community innovation centres at the sector level, which were responsible for knowledge transfer and the scaling up of successful pilot actions, and a new system of extension services based on FFSs. This system built on a partnership among farmers, extension services and agricultural research centres. The establishment of FFS enabled the involvement of beneficiaries in deciding which technologies were better performing and worth diffusing.

[9] The lack of a financial analysis to support the design of the insurance schemes posed a high risk that they would not be viable over time (IFAD, 2013, p. 22).

68. IFAD also supported the replication of pilot innovations through the provision of two investment funds to enable farmers or farmers' groups to access the necessary financial resources for replication. At design phase, special attention was given to youth and women's access to these funds.

69. During the second phase of the project, marketing support activities were established to support innovations in the livestock and agricultural intensification fields. These include the establishment of milk distribution centres,[10] the distribution of mobile phones to access the Agricultural Market Price Information System (which provides information on prices for agricultural commodity chains within the main markets in Rwanda) and a partnership with WFP within the scope of the Purchase for Progress (P4P) framework, allowing rice and maize cooperatives to supply WFP with their surplus production.

70. **Adoption.** The main innovations piloted within the watershed management cluster were adopted in response to the widespread soil degradation affecting the areas of intervention. The project put in place an integrated system of innovation, in which measures against soil erosion were the entry point to support improved livestock and agricultural production. The introduction of livestock was fostered to solve the issue of the lack of manure to be used for agricultural intensification, further supporting food security.

71. Livestock activities have been well implemented and well received by the families. Three years after implementation, livestock insemination and distribution activities showed good performance statistics. However, the mortality of local small stock (30 per cent) was a problem. The MTR suggested that more attention should be paid to the sourcing of local animals.

72. For the areas of Bugesera and Nyanza, the plants transplanted had to face a severe period of drought, which significantly reduced their recovery rate (55 per cent). This caused a loss of plants for a value of approximately US$130,000. In addition, the type of forage shrubs employed for animal feeding and soil fixation were not suitable to the high-altitude areas of Gakenke, Ngororero and Nyamagabe. This constrained the availability of fodder in those areas and reduced the quantity of milk produced. The transportation of plants grown in family nurseries in the lower areas represented a limitation, considering that the plants were usually transplanted further uphill.

73. SRI adoption was constrained by poor water management (due to the fact that the activities to rehabilitate the marshlands had not started at the time of the MTR) and cooperatives' lack of organization. The cooperatives did not have sufficient funding to purchase the inputs within the required deadlines. The beneficiaries also encountered issues with the basic production equipment and post-harvest infrastructure. Another significant challenge for rice producers was the need to plant at the correct time (normally, January and August). In fact, if planting took place late, up to 50 per cent of production could be lost. However, adjustment to the planting calendar was difficult because of the previous rice crop.

74. Seed multiplication was constrained by the absence of storage warehouses and drying areas, which were necessary for farmers to certify their seeds. This infrastructure was built in the districts of Kibaza and Rwabutazi by rice producers' cooperatives during the second phase of the project.

75. **Incentives.** The project distributed high-quality breed livestock using a revolving credit-in-kind system, known as pass on the gift (POG). This system was organized through community groups and producers' associations, following specific eligibility criteria for selecting beneficiaries based on their physical and financial capacity to

[10] In line with government policies and in response to the increased milk production, PAPSTA established six milk distribution centres on the basis of a matching grant (IFAD, 2009, p. 48).

establish required facilities (such as forage and cattle sheds). Subsidies were provided for the construction of stalls and for initial inputs.

76. Because fodder cultivation, like hedges and other soil conservation activities, required a large amount of work, agroforestry plants (*plantes agroforestrières et herbes fixatrices*) were provided for free to the farmers. This was important also because access to fodder increased the chances of eligibility for the POG scheme.

77. **Diffusion.** The pilot actions and technical innovations were initially implemented in six selected pilot watersheds in six districts, representing the major agroecological zones of the country. After the MTR in 2009, five additional areas were selected for replication.

78. As early as October 2008, the **SRI and living hedges (fodder plants)** were already replicated outside the pilot zones by the beneficiaries themselves.

79. The project completion report reported data on the diffusion of innovations under component 1 of PAPSTA, at the end of the project: 44,180 ha of degraded land were hedged and protected against erosion (443 per cent compared to the initial target); 32,950,456 agroforestry trees were produced and transplanted, equivalent to 92 per cent of the project target. The operations were performed through private and household nurseries (12.95 million agroforestry trees produced in private nurseries and 20 million agroforestry trees produced in household nurseries). However, 2,998,245 forestry seedlings were distributed, representing only 31 per cent of the 9,696,000 forestry seedlings that were planned to cover 606 ha; 683-ha layouts of progressive terraces were established (105 per cent).

80. At the end of the project, a total of 3,750 dairy cows were distributed to vulnerable households, exceeding the initial target by 285 per cent (increasing demand from beneficiaries and from the Rwandan Government). Similarly, a total of 7,580 small ruminants and 909 pigs were distributed, exceeding the initial prevision of 3,600 animals. Pigs were not distributed in certain watersheds because of the prevalent religious beliefs or of restrictive measures adopted in response to the outbreak of contagious diseases (such as *peste porcine*). Artificial insemination reached 8,257 cows (with a success rate of 50 per cent to 70 per cent), against the 3,000 foreseen. This was a direct consequence of the increased number of cows distributed and farmers' awareness on advantages related to genetic improvement, in terms of increased milk production.

81. SRI, initially piloted on two marshlands, reported high adoption rates. Success factors include mobilization and training of rice farmers, savings on the quantity of water and seeds employed, and high yields (despite the lack of a water management system). SRI was extended to new marshlands in the second phase of the project, reaching a total of 10,100 farmers trained by FFS.

Poverty relevance

82. While the integration of hedging with terracing has been successfully targeted to the most vulnerable, by virtue of the project design, most project investments were accessible only to landowning households.

83. Livestock distribution, for example, was restricted to households that owned a minimum amount of land – reportedly, 0.6 ha for goats and 0.8 ha for a cow. According to the baseline study, 46 per cent of the households in the area of intervention have less than 0.55 ha. The option for beneficiaries to either obtain a cow or small animals, depending on their land, fodder and labour availability, enabled the participation of poorer households with limited land availability. However, the attached cost of materials and labour constrained the participation of the targeted poor, especially women and orphans, who could not afford to pay their share of the contribution.

84. Involvement in soil conservation activities (e.g. digging and maintenance of anti-erosion ditches) was rewarded with food supplies from the WFP within the Food for Work programme. This activity fostered the involvement of the poorest, often landless households, which could not benefit from the POG scheme.

85. **Cost-effectiveness.** The MTR assessed the cost-effectiveness of pilot activities according to different farm models, combining cows or small livestock with crop cultivation on three different agroecological zones (half of the crops being fodder). The analysis shows a significant increase in annual income for households (from 19 per cent to 68 per cent). The most profitable models are those that included cows, because of milk sales and the increased availability of manure. However, artificial insemination has a high up-front cost. The MTR suggested that if the Government wished to extend this practice to other areas, it should ensure that the practice would be provided at an affordable price to farmers.

86. The improved rice varieties, made available from the research component, allowed farmers to save on water and labour. Compared to the traditional varieties, the rice obtained was also sold at a higher price (by 15 to 20 per cent). On the contrary, the cost of rice production under SRI was higher than the cost of production using traditional techniques. In fact, SRI required a large amount of work in terms of labour, weeding and transplanting, paddy threshing and drying.

87. **Outcomes.** The main outcomes generated by watershed protection (terracing and hedging) and marshland development activities were improved soil productivity, resulting in higher yields and income. According to the beneficiaries interviewed, the increased incomes allowed them to purchase household items and other physical assets.

88. The implementation of soil conservation activities resulted in the control of soil erosion, resulting in environmental resilience and natural resource sustainability. Increased food production was generated by SRI implementation and improved rice varieties that produced higher yields. On a targeted area of approximately 12,000 ha, the increase in production resulting from SRI adoption was of 4,000 tons per season. Increased income was also reported from the introduction of nurseries (a net profit of US$400,000 was achieved through the sale of plants).

89. **Benefits.** From a preliminary analysis, the yield in terms of t/ha for crops doubled, on average, with the project interventions. Milk production increased from 1.6 to 10.6 litres per cow following the introduction of cross-breed cows. Households increased meat consumption from 28 per cent to 45 per cent and daily vegetable consumption from 47 to 75 per cent. The number of farmers in associations tripled; farmers who were not members of associations or organizations fell from 48 to 15 per cent. However, the lack of a proper functioning M&E system constrained the ability of the project to assess the effectiveness of the pilot activities on the target group. Beneficiaries of cow distribution reported an average sale of 5 litres of milk per day, which translates into a monthly revenue of approximately 20,000 Rwandan francs. From a nutritional point of view, milk family consumption varies from 2 to 5 litres per day in households that did not consume any milk before the project.

90. **Sustainability.** In 2009, the project readjusted its strategy for the next four years. One of the main priorities was to ensure the sustainability of the successful innovations introduced by PAPSTA. This was realized involving the Ministry of Agriculture, the local administration and farmers' organizations, supporting their progressive taking charge of the initiatives. In the first five pilot zones, the private service providers were gradually disengaged.

91. The establishment of family plant nurseries allowed farmers to continue growing their own forage shrubs even after the end of the project. The establishment of progressive terraces that incorporate fodder hedges was potentially sustainable, as

the maintenance required was relatively low and the use of hedges as fodder for the animals provided an incentive for the farmers. However, further extension of the terraces required additional external funding. Furthermore, fodder cultivation may be threatened during dry season.

92. The sustainability of livestock distribution is linked to the POG system. If the discipline is maintained within the communities in passing on the animals, and if diseases do not erode the number of animals, the process should ensure the sustainability of the initiative. The sustainability of the livestock interventions also relied on the formation of breeding cooperatives, which managed the sale of veterinary supplies and livestock food. The discontinuity of subsidies supporting the construction of stalls might also pose a challenge for the sustainability of the livestock intervention, especially because the POG system for materials did not spread across all project districts.

93. The sustainability of the SRI was linked to the ability of producers' cooperatives to restructure themselves after the end of the project and become independent, relying on increased revenues.

94. **Scaling up.** SRI and fodder cultivation spontaneously spread out of the pilot zones during the first three years of implementation. The testing and implementation of the various innovations promoted by the project led to the publication of a number of standard technical packages that are currently used by the national extension service and other development partners all over the country.

95. Scaling up was a design feature of the project that enabled local districts to take charge of project initiatives and incorporate them into their planning process. However, the scaling up strategy did not contain a thorough analysis of the human and financial resources of the district, which are fundamental to ensure medium- or long-term sustainability.

96. Some innovations from PAPSTA were replicated in the Kirehe Community-based Watershed Management Project (KWAMP), a subsequent IFAD project concentrated in a single district (Kirehe). As far as technical innovations are concerned, SRI, *bocage* and seed multiplication were replicated with slight changes, incorporating lessons learned from PAPSTA. SRI, for example, was adapted to the new project and did not include water management. Higher investments in dams compensated for the missing water component, available in the adapted SRI package. Participatory approaches and enabling factors, such as the animal health insurance scheme, the in-kind revolving credit system (POG) for livestock distribution and the establishment of community centres for innovation and watershed management committees, were also replicated in KWAMP.

97. **Lessons.** A specific component of the project was dedicated to piloting innovations aimed at fighting soil degradation. The project adopted an integrated approach, called "*Bassin Versant*" (watershed area), combining soil protection measures (entry point for agricultural intensification), livestock distribution and agricultural intensification. Beneficiaries were motivated in performing soil protection activities so that they could access forage shrubs and become eligible for the POG scheme, receiving improved-breed livestock, which would in turn increase the availability of manure for agricultural intensification activities. The direct association of watershed protection activities with farmers' production activities having income-generating potential fosters the participation of a large number of beneficiaries.

COUNTRY	Bangladesh
PROJECT NAME	Microfinance for Marginal and Small Farmers Project
IMPLEMENTATION PERIOD	2004-2010
PROJECT TYPE	Credit and financial services

98. **Context.** Bangladesh is one of the fastest-growing countries worldwide. Over the last seven years, the annual GDP growth rate has averaged 6 to 7 per cent and is expected to exceed 7 per cent per year for the next five years. Despite promising developments in the field of innovation and poverty reduction, Bangladesh has a high poverty rate (24.3 per cent of its population lives below national poverty lines), with approximately 25 million people living below the extreme poverty line of US$1.90 per day. While only 4.3 per cent of the urban population lives in poverty, rural areas show a higher poverty rate, reaching 35.2 per cent.[11]

99. In Bangladesh, the microcredit sector is well established, relying on NGOs acting as microfinance institutions and channelling funds to the landless poor. However, this system has not catered adequately to smallholder farmers (also known as "small" or "marginal" farmers), who also had limited access to credit for agricultural purposes from banks.

100. **Project.** The Microfinance for Marginal and Small Farmers Project was conceived to introduce an innovative approach to the delivery of financial services to small and marginal farmers, in partnership with Palli-Karma Sahayak Foundation (PKSF), the apex organization in the country, by providing funds to microfinance institutions. Launched in 2005, the project covered 14 districts in northwestern and north-central Bangladesh over a period of six years, "to provide improved livelihoods to 210,000 poor small and marginal farmer households".

101. **Innovation.** The microcredit component was complemented by the introduction of five new crop-related technologies: LCCs and urea super granules (USGs) for efficient fertilizer use in rice production, pheromone traps for reduced use of pesticides in vegetable cultivation, AWD for rice production, and the Maria model for seed production and preservation.

102. **Identification.** The technical innovations were identified through the assessment of the priorities of farmers' groups performed during the implementation phase of the project. More general, the need for crop-related technical innovations aimed at increasing agricultural productivity stemmed from the National Agricultural Strategy for Bangladesh,[12] in line with IFAD's Strategic Framework for Poverty Reduction and Regional Poverty Strategy for Asia/Strategy for Poverty Reduction in Asia and the Pacific.

103. The introduction of LCCs and USGs was linked to a shortage in the availability of urea, a fertilizer, which in turn limited agricultural production. This shortage was the result of a government policy, and was exacerbated by illegal exports of urea out of Bangladesh.

104. **Strategy.** A partnership with the Bangladesh Rice Research Institute supported interventions in paddy and provided residential training at the Institute's training centre for eight batches of technical officers (TOs) and assistant technical officers (ATOs).

[11] World Bank data. Available at: https://data.worldbank.org/indicator/SI.POV.NAHC?locations=BD&view=chart
[12] "D) increasing agricultural productivity (both land and labour) through a combination of research output, improved support services, capital investment, increased input application, better land use and more efficient input use. This will both ensure food security and release land for diversified crops" (IFAD, 2003, p. 7).

105. Technical support was provided in the form of farmers' groups technical trainings, demonstrations and field visits by the Department of Agricultural Extension. Follow-up training was performed by TOs and ATOs, who were hired by the POs through project funding. From interviews with beneficiaries, it appeared that the Department's training models were not developed assessing specific farmers' needs[13] and trainings were mainly conducted in the form of classroom teaching. The ATOs and TOs provided more practical and on-the-field training during weekly meetings.

106. **Adoption.** Investigations in the field by the MTR mission highlighted several factors influencing adoption. For example, seed preservation (for which Maria Seed Treatment is used) and vegetable cultivation (for which pheromone traps are used) are typically performed by women, who reported higher rates of adoption after training. LCCs had been demonstrated in almost all groups and were popular among farmers. However, its adoption was constrained by the lack of availability of the charts.

107. Delays in the supply of LCCs further slowed their distribution to the farmers, which only took place in the fourth year of the project. Also, an average of two to three charts were provided to groups of farmers, which constrained their usage. Many farmers could not read properly and were therefore unable to read the instructions on the back of the chart.

108. Not all technologies could be employed in all target areas. AWD, for example, was relevant mainly in areas prone to flooding, and not where deep tube wells were used. The spread of USGs was constrained by the fact that it was relevant mainly in clay-like soils. The adoption of USGs was further constrained by two factors. First, USG was not widely available, as it had to be produced from standard prills of urea (small pellets) using a special briquetting machine, which was not popular in Bangladesh. This issue was solved in 2007/2008, when a national programme provided briquetting machines. Second, the application of USG in the field manually was highly labour-intensive. In relation to this, the project introduced 400 applicator machines to project partner organizations (POs).

109. Despite the promotion of IPM by the Department of Agricultural Extension , pesticide sales suggest that farmers continued to use increasing amounts of insecticide. This appeared to be linked to the limited efficacy of pheromone traps in controlling the stem borer, the most serious pest affecting rice cultivation.

110. **Diffusion.** Given the demonstrated positive impact on net income and the interest shown by farmers, the introduction of new technologies was successful. In general, most respondents who received training (over 90 per cent for all technologies) found the technology useful. Adoption rates varied between 50 per cent (for AWD) and 77 per cent (for Maria Seed Treatment) of the respondents. Regarding specific agricultural technologies, many beneficiaries who received training reported having disseminated the technologies to others.

111. According to the POs' progress report, it was found that around 29,815 farmers of 25 POs had used LCCs by June 2011. Training on USGs was provided to 9,514 beneficiaries and 890 demonstrations were organized for farmers. As of June 2011, approximately 47,228 farmers from 25 POs had used the technology.

112. The project, in collaboration with the Rural Development Academy and Bangladesh Rice Research Institute, distributed 32,600 porous pipes to the beneficiaries. By June 2011, 10,302 farmers had used the porous pipe for irrigation purposes and

[13] "Training needs assessment has also proved problematic in so far as farmers are often unable to identify their training needs in the absence of knowledge about new technologies. However the alternative of simply using a standard pre-conceived training module risks teaching farmers what they already know or what is not relevant. Ideally the technical officers of the POs should themselves be made aware of promising new technologies and then in discussions with beneficiary groups assess what training the farmers need" (IFAD, 2008, annex I, p. 39).

271 demonstrations had been conducted. However, AWD uptake remained low. This technology is only truly suitable in areas dependent on pumped water, while it is not entirely useful in low-lying areas where water is raised by more traditional means. The main problem, however, is that farmers usually pay pump owners a fixed price for water for one season, and there is little incentive for pump owners to pass on any "savings". Currently, therefore, the technology is largely restricted to farmers who own their own pumps and can benefit from savings.

113. By June 2011, the project had arranged training on the Maria model for 41,947 beneficiaries, and 811 demonstrations on seed production and preservation following the Maria Model; overall, 24,534 farmers of 25 POs stored rice seed using this technology. Twenty-eight thousand pheromone traps had been distributed to the beneficiaries and 461 demonstrations organized in the field using the pheromone trap; approximately 1,435 farmers reportedly used the technology.

114. **Poverty relevance.** LCCs were easy-to-use and inexpensive. This diagnostic tool was used for efficient urea application in rice fields by monitoring the relative greenness of a rice leaf. Using this tool, farmers could easily top dress the required amount of urea, comparing rice leaf colour with the LCC colour strips. This helped to avoid overuse of fertilizers and thus reduced the cost of urea for farmers.

115. **Cost-effectiveness.** USG contributed to a reduction in the amount of urea needed by 30 per cent and to an increase in yield by 10 per cent. According to the 10 POs surveyed by PKSF, the use of USG generated savings in urea of up to 40 per cent compared to traditional prills. This represent a cost saving of BDT[14] 1,350/ha. At a time when urea supply was limited and the price had increased, the use of USG appeared to be a cost-effective measure.

116. Pheromone traps were described as a low-cost and environmentally friendly insecticide. It was observed that farmers who used the pheromone trap in their eggplant plots to control the fruit and shoot borer, and in cucurbits to control the fruit fly, saved up to 50 per cent in costs for insecticides, and achieved increases in production by approximately 25 per cent for the same area of land. LCC was a labour-intensive practice that required frequent visits to the field, which increased the labour costs by BDT 500/ha approximately. Nevertheless, the implementation of such practice reported yield increases (of 5 to 10 per cent) and savings on urea (20 per cent). Farmers reported a slight yield increase and a small saving, deriving from lower water usage. A survey conducted by PKSF indicates that the number of irrigations during the *boro* season can be reduced from 18-20 to 10-14 when using PP. This, in turn, means that approximately 40 per cent less water is needed on average, and that farmers can reduce the amount of diesel required for pumping by averagely 15 litres per season, resulting in substantial cost savings (BDT 7,300/ha).

117. **Outcomes.** Most of the adopters reported yield increases and a reduction in production costs to varying degrees. As per the PCR, the use of LCCs could lead to a 5 to 8 per cent yield increase, of USGs to a 10 per cent yield increase, AWD to a 4 per cent grain yield increase and the pheromone trap to a modest yield increase. As the majority of priority technologies for rice production were predominantly intended for home consumption, the increase in yields positively affected food security.

118. Overall, the project had a positive impact on natural resources and the environment. The two fertilizer-related technologies that were promoted, USG and LCC, contributed to the reduction in use of urea fertilizer by farmers, while pheromone traps served to reduce the use of chemical insecticides. AWD technology reduced excess groundwater pumping. Further, short-duration rice

[14] Bangladeshi taka.

varieties were introduced as an adaptation measure to climate change (delayed rain season).

119. Female beneficiaries reported the acquisition of new skills, such as improved rice seed preservation (Maria Seed Treatment) and the use of pheromone traps for eggplant and cucurbit cultivation, which reduced expenditures and enhanced income, thereby raising their status in the household and in the community.

120. **Sustainability.** All five technologies introduced by the project were simple and low-cost, presenting good potential for continuous adoption by farmers and increases in returns; however, sustainability requires follow-up activities. These innovations are environmentally sustainable, contributing to the reduced use of agrochemicals.

121. Two issues require specific attention. First, the group-based approach at the basis of the microcredit system could be compromised by high dropout rates, mainly influenced by the "graduation" of some borrowers from microcredit, and a lack of project activities attached to the funding. Second, the, technical support and training by NGOs/microfinance institutions may not be sustainable without project funding. If not properly tackled, these issues may affect the sustainability of the five technologies.

122. The sustainability of USGs is also linked to the availability of applicators. While they were distributed free-of-charge by the project, their cost is relatively high. Moreover, these machines need frequent repairs, such that a repair system should be established to ensure the sustainability of the technology. However, local production of applicators appears to be a promising factor, in terms of the future sustainability and diffusion of the innovation.

123. **Scaling up.** There are clear indications that most of the technologies promoted will continue to be used by beneficiaries, and that the use of these technologies was already spreading spontaneously. As indicated, many more pheromone traps were being used by beneficiaries than were originally distributed, and there were signs that farmers were increasingly using USG.

124. The replication of pheromone traps was reported in subsequent IFAD projects in Bangladesh. Although the focus was on scaling up the innovative microcredit component, the Microfinance for Marginal and Small Farmers Project was followed by another IFAD project, Finance for Enterprise Development and Employment Creation (FEDEC), which was implemented by PKSF. Through its microenterprise loans, FEDEC launched 42 subprojects, which provided technical services to farmers. These included the promotion of both pheromone traps and livestock vaccination, introduced in an earlier IFAD project in Bangladesh, the Microfinance and Technical Support Project.

125. **Lessons.** The incorporation of agricultural expertise, through the appointment of TOs and ATOs, proved to be an effective way of providing farmers with technical knowledge. The main function of ATOs and TOs was catalytic, in that they helped farmers understand the details of technologies that they were already aware of, rather than teaching them about the overall technology from scratch. This raises the possibility, in future projects, of minimizing the amount of formal training and focusing on providing access to technical expertise on an ad hoc basis.

126. The project has demonstrated quite clearly that it is better to focus on the promotion of a limited number, rather than a wide range, of technologies. This was not fully recognized at the design stage, and the design allowed for a wide range of technologies to be promoted based on the perceived needs of farmers at different locations. This demand-driven approach did not appear very successful. During implementation, it was decided to limit the number of technologies promoted; this appears to have been successful. Furthermore, the most successful technologies, in

terms of adoption rates, tend to be simple, to have a low cost, or to be cost-effective for farmers.

Approaches to innovation by other IFIs

1. The analysis conducted in this synthesis took a twin-track approach to benchmarking IFAD's performance and the external validity of the findings by comparing (a) project-level performance; and (b) innovation practices.

2. IFAD's strategy for innovation, with an embedded systematic process, capacity-building efforts for staff, and working in the context of partnerships is closely mirrored by the approaches taken by other major development partners, including the World Bank,[1] the Asian Development Bank (AsDB)[2] and the African Development Bank (AfDB).[3] The other Rome-based agencies, WFP[4] and FAO share comparable approaches.[5] In addition, IFAD has recently become a member of the United Nations Innovation Network. This Network spans 11 funds and programmes, promoting an approach characterized by three pillars: building an architecture to promote innovation; activating partnerships and building an innovation ecosystem; and creating a culture of innovation.

3. Of note for this synthesis are the differing emphases on technology. The World Bank characterizes innovation as bringing new products, new processes, and new forms of organization into economic use – without any specific consideration of technology. AsDB's Guiding Principles for its Strategy 2030: Achieving a Prosperous, Inclusive, Resilient, and Sustainable Asia and the Pacific, highlight promoting innovative technology and conceives the adoption of advanced technologies as integral to agricultural productivity and food security. The AfDB Feed Africa: Strategy for Agricultural Transformation in Africa 2016-2025, recognizes the importance of contextually appropriate technology; however, it envisages the technology challenge as being one of dissemination rather than innovation.

4. Importantly, the definition of innovation adopted by IFAD and refined in this report is widely shared. A key feature is that innovation is about change that is new to the context, irrespective of whether it is new in nearby localities, elsewhere in the country, or in the world.

5. It is not possible to draw direct comparisons on project performance with respect to innovation. No partner agencies have such a comprehensive performance rating system as that employed by IFAD; therefore, there are no direct comparators of project or country programme performance as regards innovation from completion reports and similar portfolio reviews.

6. Evaluation reports from partners do offer insight and comparisons with the findings in this synthesis, although none have been found that focus specifically on technology. One study from the World Bank[6] and two from the AsDB[7] contain findings that echo the analysis performed in this synthesis, although the remit of

[1] The Innovation Policy Platform (IPP), developed by the World Bank Group and the Organisation for Economic Co-operation and Development (OECD), is a web-based interactive space that provides easy access to knowledge, learning resources, indicators and communities of practice on the design, implementation, and evaluation of innovation policies.
[2] The AsDB 2009 Operational Plan for Sustainable Food Security in Asia and the Pacific refers to innovation. Innovation features: as an output indicator under enhanced knowledge and technology; as part of support to agricultural research; and for strengthening staff skills. In 2017, the Bank Established a High Level Technology Fund that addresses the challenge of innovation. Innovative technology is presented as part of the Vision, Value addition and Guiding Principles of the Strategy 2030, published in 2018.
[3] The Feed Africa: Strategy for Agricultural Transformation in Africa 2016-2025 embraces innovation, although the challenge relating to technology is presented as one of dissemination rather than innovation.
[4] The WFP Innovation Accelerator, established in August 2015.
[5] The Tropical Agriculture Platform is a multilateral facilitation mechanism with the aim of fostering better coherence and a greater impact of capacity development for agricultural innovation systems in tropical countries.
[6] World Bank Group Support for Innovation and Entrepreneurship. IEG, September 2013.
[7] AsDB, *Learning lessons Agricultural Value Chains for Development* (2013); AsDB, *Thematic Evaluation Support for Small and Medium-Sized Enterprises, 2005–2017: Business Environment, Access to Finance, Value Chains, and Women in Business* (2018).

those studies was multisectoral and wider than technical innovation. The 2013 study conducted by the World Bank, titled "World Bank Group Support for Innovation and Entrepreneurship: an evaluation" found, in a comparison between innovative projects rated as successful or unsuccessful, that the main factors were overly complex design, inadequate risk assessment, poor supervision and inadequate performance by the borrower. Lessons from the 2012 AsDB study on "Support for Agricultural Value Chain Development" argued that value chains need continuous inputs for innovation and technology to raise productivity, reduce costs and remain competitive. In the context of value chains, the study distinguished between *innovation* as a continuous process that can involve stakeholders at any point in the chain to improve production, product quality, and marketing processes and *technology*, which is either imported as a turnkey package or is the output of research and development. That distinction is potentially significant in the context of the United Nations Secretary General's Strategy on New Technologies and highlights a tension in global interpretations regarding the relationships between technical, social and institutional change. The study also argued for integrating research into project designs, rather than as a standalone objective.

7. An AsDB thematic analysis into support for small and medium enterprises argued that improving access to finance was insufficient in the absence of other support dealing with capacity constraints, including a wider use of technology and innovation.

Benchmarking information

8. The guiding question is: "where does IFAD stand in relation to partner and comparable agencies?"

	Policy and strategy
World Bank	2012 Agricultural Innovation Systems. An investment sourcebook. Seven modules on the agricultural innovation system approach, with principles of analysis and action. Definition is in line with IFAD and this ESR: Innovation is the process by which individuals or organizations master and implement the design and production of goods and services that are new to them, irrespective of whether they are new to their competitors, their country or the world. An innovation system is a network of organizations, enterprises and individuals focused on bringing new products, new processes and new forms of organization into economic use, together with the institutions and policies that affect their behaviour and performance.
African Development Bank	Feed Africa: Strategy for Agricultural Transformation in Africa 2016-2025. The document refers to innovative finance and extension models and features links to gender and cross-cutting issues (p. 35); More generally, it contains a development of context-appropriate agricultural technologies and their distribution (p. 16). The Feed Africa Strategy perceives the issue as being the *dissemination* of technology; there are infrequent references to innovation. See annex IV, figure 20.
Asian Development Bank	The 2009 Operational Plan for Sustainable Food security in Asia and the Pacific refers to innovation: as an output indicator under enhanced knowledge and technology; as part of support to agricultural research; and as strengthening staff skills. The challenge of innovation is addressed in the 2017 Establishment of a High Level Technology Fund. In the 2018 Strategy 2030: Innovative technology is part of the Vision, Value addition and guiding principles (see p. 10, figure 5). There are strong links to agricultural production, food security and value chains. Para v, p. vi: v. Promoting rural development and food security. ADB will support efforts to improve market connectivity and agricultural value chain linkages. It will help DMCs increase agricultural productivity and food security by boosting farm and nonfarm incomes, promoting the adoption of advanced technologies and climate-smart agricultural practices, and supporting the improvement of natural resource management standards. It will also help DMCs enhance food safety. (N.B. DMC: developing member country)

	Regular performance reporting
World Bank	Innovation is not included as part of the Independent Evaluation Group's (IEG's) Implementation Completion and Results Report (ICR) review methodology, on which the annual results and performance of the World Bank Group are based. The Implementation Completion and Results Report Review (ICRR) Guidelines do note that a reviewer may invoke innovation as grounds to propose a field assessment of an ICR. *No comparative statistics for IFAD*
Asian Development Bank	No references to innovation as part of the annual portfolio performance report (APPR). There are references to technology; however, these only regard ICT (2017). The 2017 Development Effectiveness Review references innovation in the context of SDG 9, but not with regard to the agricultural sector. The 2010 sector synthesis of Post-Completion Evaluations for agriculture and natural resources does not provide analyses related to innovation. Agricultural productivity growth is identified as a key element of interventions, with a lesson that projects should have suitable improved technologies. *No comparative statistics for IFAD.*
African Development Bank	Project Completion Report (PCR) and Project Performance Evaluation Report (PPER) guidelines include innovative projects as a criterion for selection; however, the reviews themselves do not contain references to innovation. The 2013 results management framework makes limited references to innovation, although these mostly concern how the AfDB operates. The AfDB's Feed Africa strategy (see below) features one area of support to the enhancement of agricultural productivity by using modern technologies, and mentions "Level 2" indicators for the number of people trained to use improved technology. *No comparative statistics for IFAD.*
United Nations	Three United Nations Innovation Network members integrate innovation into their integrated results and resources frameworks, at the level of outputs/outcomes and into concrete indicators: the United Nations Development Programme (UNDP); the United Nations Refugee Agency (UNHCR); and the United Nations Children's Fund (UNICEF). *UNDP (Integrated results and resources framework 2014-2017)* Output 7.6: Innovations enabled or development solutions, partnerships and other collaborative arrangements Indicator 7.6.1: Number of new public-private partnership mechanisms that provide innovative solutions for development Indicator 7.6.2: Number of pilot and demonstration projects initiated or scaled up by national partners (e.g. expanded, replicated, adapted or sustained) See also indicator 1.1.3 (productive technology) (data available for 2014-2017) The UNDP Results-Oriented Annual Report, completed by all country offices, features a section on innovation. Similarly, UNICEF country offices report through the Country Office Annual Report, which features two innovation-related questions. The information is not specific to agriculture. In some instances, innovation is incorporated into integrated results and resources frameworks; however, it is not operationalized in indicators. The 2016-2021 Unified Budget, Results and Accountability Framework,[53] the Joint Programme instrument operationalizing the UNAIDS Fast-Track strategy to end the AIDS epidemic by 2030) features output 7.3, formulated as: "technological, service delivery and health innovations fostered." The narrative of this output points explicitly to the promotion of innovation in HIV service delivery, including mobile health, eHealth and telehealth. The UNFPA Integrated Results Framework 2014-2017 includes an output, under organizational effectiveness and efficiency, formulated as "increased adaptability through innovation, partnership and communication." There are no specific indicators on innovation associated with this output. The United Nations Women Integrated Results Framework 2014-2017 does not include any outcomes, outputs or indicators that are explicitly related to innovation (see United Nations Population Fund, *Formative Evaluation of the UNFPA Innovation Initiative* [Geneva: 2017], p. 29).
World Bank	*Evaluation* World Bank Group support for innovation and entrepreneurship: an independent evaluation (September 2013) Tables of analysis Data from World Bank, International Finance Corporation (IFC) and Multilateral Investment Guarantee Agency (MIGA) project databases between FY2000 and FY2011 help to identify both closed and active projects focused on innovation and entrepreneurship. World Bank sector and theme codes, however, do not use innovation, entrepreneurship, or related terms to report on Bank activities; nor do IFC or MIGA have a system that officially records or tracks innovation. Thus, the IEG adopted an alternative approach to identify relevant projects and activities (appendix B; p. 17).

Projects were selected by means of a combination of keyword search and direct inspection of development objectives and components, with necessary variations between the three agencies.

Table D.2. Lending on innovation components, by income category

Income category	*Lending for innovation components (US$ millions)*	*Number of projects*	*Average lending per project (US$ millions)*
Lower	1,352	48	28
Lower-middle	708	36	20
Upper-middle	1,711	22	78
Total	3,771	106	36

Source: World Bank.
N.B.: n = 106. In thirteen projects (all active projects), the lending related to innovation and entrepreneurship was not identifiable.

Table D.3. World Bank project component lending, by region

Closed				*Active*		
	Lending for innovation components (US$ millions)	Number of projects	Average lending per project (US$ millions)	Lending for innovation components (US$ millions)	Number of projects	Average lending per project ($ millions)
AFR	223	19	12	843	21	38
EAP	293	6	49	143	2	71
ECA	199	8	25	193	5	39
LAC	612	24	26	954	10	95
Other	196	7	28	115	3	38

Source*:* World Bank.
N.B.: AFR = Africa Region; EAP = East Asia and Pacific Region; ECA = Europe and Central Asia Region; LAC = Latin America and the Caribbean Region.
n = 106. In thirteen projects (all active projects), the lending related to innovation and entrepreneurship was not identifiable.

Table D.4. World Bank project component lending, by sector

Closed				*Active*		
	Lending for innovation components (US$ millions)	No. of Projects	Average Lending per Project (US$ millions)	Lending for innovation components (US$ millions)	No. of Projects	Average Lending per Project (US$ millions)
ARD	520	21	25	444	11	40
ED	590	7	84	376	6	63
FPD	330	28	12	1,096	18	61
Other	83	8	10	332	7	47

Source*:* World Bank.
Note: ARD = agriculture sector; ED = education sector; FPD = finance and private-sector development sector
n = 106. In thirteen projects (all active projects), the lending related to innovation and entrepreneurship was not identifiable.

Chapter 4

CHAPTER 4
PORTFOLIO PERFORMANCE OF WORLD BANK GROUP SUPPORT FOR INNOVATION AND ENTREPRENEURSHIP

Table 4.1. Factors associated with project performance in World Bank projects

	Projects with unsatisfactory outcomes		*Projects with satisfactory outcomes*		
Performance issue	Number	%	Number	%	Ratio
Inadequate supervision	8	62	5	10	6:1
Overly complex design	6	46	14	27	3:1

Lack of stakeholder involvement	1	8	2	4	2:1
Inadequate technical design	10	77	20	39	2:1
Inadequate risk assessment	3	23	3	6	4:1
Inadequate M&E framework, poor data quality/indicators	10	77	31	61	1:1
Inadequate skill mix of bank team	3	23	0	-	-
Inadequate borrower performance	11	85	9	18	4:1
Implementation disrupted by a crisis	4	31	8	16	2:1
Number of projects	13		51		

Source: IEG.
Note: M&E = monitoring and evaluation.
a. This is a ratio of unsatisfactory to satisfactory outcomes, expressed in terms of percentages.

The main problems with project performance were associated with the Bank's role, irrespective of whether projects achieved their objectives. The issues were related to project design (complex design, unrealistic targets, inadequate M&E) and quality of supervision. On the borrower side, problems were caused by inadequate performance of government and implementing agencies and implementation delays (in this regard, there is potential for comparison with IFAD results).
A number of interesting features emerged from this analysis. As for design, inadequate technical design appears almost as often in successful projects as in unsuccessful ones. As many projects with inadequate M&E fail as those that succeed. Having regard to implementation, problems occurred on both the Bank and the borrower side. Furthermore, all projects were affected by implementation problems. Setbacks occurred in projects that did not achieve their development outcomes and in projects that successfully achieved them.

The support provided by the Bank has a much broader coverage than that of IFAD. An analysis conducted for four countries selected for the study (Brazil, China, Chile, and Kenya) shows that while the greatest investment by far was in strengthening entrepreneurial capabilities, other innovations covered support to public research and development, financing schemes and fostering linkages (see text, pp. 57 et seq).

AsDB

Support for Small and Medium-Sized Enterprises, 2005–2017: Business Environment, Access to Finance, Value Chains, and Women in Business
The analysis identifies a lack of capacity to innovate. SMEs include agricultural processing and businesses; however, there is no specific analysis for the sector.
"ADB's operations in access to finance focused mainly on addressing the supply-side issue of lack of SME access to finance. There were no operations to address demand-side issues such as the capacity constraints of SMEs. The lack of capacity and skilled workforce, the limited use of technology and innovation, and the lack of access to product markets were key issues that were not addressed by ADB's operations." (see linked document F, para 53).
2013 Validation Report for the Indonesia: Poor Farmer's Income Improvement through Innovation Project. The PCR provided a rating of "Highly Successful" (downgraded during the validation to "Successful").

Emphasis is placed on innovation and technology in *Evaluation Knowledge Study – Support for Agricultural Value Chain Development*, October 2012, and *Learning lessons – Agricultural Value Chains for Development*, June 2013

Other analyses

World Bank

The Innovation Paradox, 2017

This document contains an analysis about why developing countries engage less in innovation than advanced countries, despite the critical role of innovation in modern growth theory and in how countries achieve prosperity.

Innovation is defined (in business terminology) as follows: "[innovation] primarily involves the process of adoption of existing technologies, the process of copying or imitating attributes from other products, or the adoption of new managerial and organizational practices or business models from other companies."

Good Innovation Policy Design Checklist (box 6.2, p. 118)
The project management and innovation literatures identify the following key dimensions of good innovation policy design (RIME). These are evaluated in the PER review process.
1. Rationale:

- Is there a documented market or system failure to be addressed?
- Is there a clear statement of goals, beneficiaries, and measurable outcomes?

	• How will the proposed solution interact with the rest of the policy mix? • Does the proposed solution take into account how local context may make an alternative policy more efficient? • Does the measure consider the relative strengths of the public and private sectors? • Has the proposed solution anticipated potential capture in its design? 2. Intervention model: ■ Is there a logical model integrating theory, assumptions, and how inputs lead to outcomes and impacts? 3. Monitoring and evaluation methods: • Are there monitoring and evaluation (M&E) approaches and systems set up at the design stage? • Are there clear procedures for M&E feedback to inform the evolution of policy? *Source:* Based on Rogers 2017; Wu and Ramesh 2014. *See also box 7.5, p. 165 titled "Agriculture Extension: The case of EMBRAPA"*
UNDP	*Innovation Facility, 2016 year in review – Spark, scale, sustain: Innovation for the Sustainable Development Goals* places a strong emphasis on technology.
UNFPA	*Formative evaluation of the UNFPA Innovation Initiative*, July 2017, includes a comparative analysis.
WFP	WFP Innovation Accelerator: Annual Report 2017 (May 2018).

Evaluation framework

Questions for innovation synthesis	
0. GENERAL INFO	
# Evaluation	
Country	
Project name	
Approval date	
0.5 Closing date	
0.6 List of technologies/strategy for innovation	
Project area	
0.8 Total number of beneficiaries	
Overall goal Specific objective(s) (if technology-related)	
1. Relevance	
Poverty relevance To what extent was the innovation pro-poor?	
1.2 Strategic relevance Was the innovation in line with the relevant national strategy (or strategies)?	
1.3 Relevance of partners How relevant and appropriate was the choice of partners?	
1.4 Relevance of enabler support How relevant was the support to enablers that was provided?	
2. Effectiveness	
2.1 Results What technical innovations were implemented? (e.g. agricultural tools, crops, energy, fertilizers and chemicals, fisheries, forestry, land management practices, livestock, planting techniques and practices, post-harvest and processing, seeds, water)	
2.2 Pro-poor or equitable benefits To what extent were the benefits pro-poor or equitable?	
2.3 Innovation enabling fact. Were associated financial, institutional and social interventions also innovative?	
2.4 Success of enabler support Was the support provided to enablers a necessary factor for success?	
2.5 Scaling up In what ways has the innovation been scaled up: Organizational scaling-up? Appropriation by partners? Scaling from practice to policy?	
2.6 IFAD processes for innovation design or implementation	

Were IFAD processes effective in providing support to the design and implementation of innovation?	
3. Efficiency	
Cost-effectiveness Is there evidence on cost-effectiveness?	
3.2 Efficiency Is there evidence that technical innovations have increased efficiency and reduced risk?	
4. Impact What is the impact of the technical innovations on rural poverty? Are there specific details about quantified productivity; processing; social effects (assets/consumption/GEEW); knowledge and behaviour; ENRM; and resilience? Use the IOE Impact domains below.	
4.1 Household incomes and assets	
4.2 Human and social capital	
4.3 Food security and agricultural productivity	
4.4 Institutions and policies	
4.5 Gender and youth	
4.6 ENRM and climate change	
4.7 Project types or intervention models Are any particular project types or intervention models more successful in promoting technical innovation?	
4.8 Impact on partners To what extent did IFAD-supported innovations contribute to changes at the institutional/sector/policy levels?	
5. Sustainability	
5.1 Sustainability How sustainable were the technical innovations supported by IFAD? What were the factors?	
5.2 Sustainability: enabling or disabling factors What is the sustainability of the enabling or disabling factors identified?	
6. Good practices	
6.1 Enabling factors	
Empowerment and social capital	
Access and empowerment	
Demonstration plots and training	
Information and communication technologies	
Social networking and peer learning	
Finance	
Financial literacy and advice on risk management	
Insurance	
Transfers, credit and incentives	

Institutional rules and regulations	
Community infrastructure	
Contract farming	
Cooperatives and farmer federations	
Farming certification	
Land titling and property rights	
Marketing	
6.2 Disabling factors	
6.3 SUCCESS (AND LACK OF SUCCESS) [What worked well and what did not?]	
6.4 Lacking good practices In which areas are good practices not applied or lacking?	
7. Lessons learned	
7.1 Lessons learned What are the lessons learned from this review?	
7.2 Lessons from other international organizations What are the lessons that could be learned from other international organizations?	
8. Recommendations	
8.1 Recommendations Recommendations for technical innovations for rural transformation and poverty eradication (opportunities).	
9. Limitations Limitations of technical innovations for rural transformation and poverty eradication.	
X. Other/notes Comments that do not fall under the above categories.	

Descriptions and examples of interventions

Intervention	*Sub-intervention*	*Examples*
Crop types	Improved/new varieties	New or improved varieties of the following crops were introduced: roots, bulbs and tubers (including cassava, onion, yam, cocoyam, potato, sweet potato, turmeric, ginger); tree crops (including mango, papaya, palm tree); field crops (including maize, soybean, groundnut, peanut, cowpea, millet, fava beans); fodder crops (including alfalfa, barley); biofuel crops and high-value crops (including tea, coffee, sorghum, jatropha); vegetables[1]. The new or improved crop characteristics included: culinary or physical characteristics, such as seedlessness; field performance/production characteristics, such as high-yielding or short-duration varieties; abiotic stress tolerance/climate-smart varieties, such as drought or salinity tolerance; and biotic stress tolerance, such as pest and disease resistance.
	Diversification	The range of crop types introduced included: vegetable species, including spiny bitter cucumber, melon, chilli, summer tomatoes; cash crops/high-value crops, including flowers, asparagus, coffee, patchouli, castor, pyrethrum, saffron, oil palm; tree crops, including pistachio, Indian butter tree, acacia, olive, almond, apple, cherry, carob; field crops, including soybean and mung beans; fodder crops, including elephant grass and Napier grass; roots and tubers, including cassava, potato, sweet potato, ginger, arrowroot; and various perennials, including bananas, hibiscus, grape, pineapple.
	Improved rice varieties	Improved rice varieties include saline-tolerant rice varieties for climate resilience, high-yielding varieties, short season rice, drought- and stress-tolerant varieties, *Nerica* and special-flavoured rice varieties.
Crop management	Improved crop management techniques	Improved crop cultivation techniques were introduced in 21 countries, across five regions. In 16 cases, there is only a general mention of improved crop production methods in the evaluation reports, without further detail as to the precise nature of the innovations. The range of crops included vegetables (in seven projects), roots and tubers (three projects), maize (two projects) and fodder crops (two projects). Specific management practices listed in the evaluation reports included mulching, seedling nurseries, crop establishment and spacing, timing of planting, and harvesting. In India, improved *jhum* (shifting cultivation) was introduced, which comprised integration of diversified cash crops, multipurpose trees and homestead vegetable production.
	Rice production techniques (including SRI)	Out of 15 innovations related to rice production techniques, 10 specifically referred to SRI. Other innovations included the introduction of a second season to irrigated rice and proper weeding.
	Intensification	New practices for more intensive farming included off-season vegetable production and organic agriculture, crop intensification through improved water use, integrated soil fertility and pesticide management.
	Integrated crop management techniques	Four crop management techniques referred specifically to an integrated approach. These included organic coffee production, application of *Moringa oleifera* phytohormones, pollinization of palm trees, and integrated crop management techniques for legumes (pest, soil and nutrient management).
	Protected horticulture/floriculture	Protected horticulture and floriculture included greenhouse crop production, shade-cloth greenhouses, polyhouse cultivation of flowers and strawberries, and vegetable production in net houses.

[1] The specific species or types of vegetables were not indicated in the evaluation reports.

	Orchard	Interventions focused on orchard management included organic apple production, establishment of fruit tree nurseries, and rehabilitation of old olive groves through deep pruning.
	Grazing/forage	Improved cultivation of forage (*Pennicetum* grass cuttings) and fodder production techniques, as well as backyard forage development.
	Water	Water-related crop management innovations were mentioned in two instances: in the establishment of hydro-agricultural facilities for market gardening and in raised bed planting packages for water conservation.
	Diversification	Off-season vegetable cultivation (e.g. chilli)
	Harvest	Innovative harvesting techniques to reduce tree damage combined with simple, labour-saving technology for Brazil plum, ouricoury palm and cassava production.
Livestock	Improved breeds/artificial insemination	Interventions focused on the introduction of improved breeds and activities included the introduction of rams, cockerels, German Alpine and Toggenburg dairy goats, ducks, genetically improved rams and bucks, and Sardi stud rams. There were four instances of artificial insemination and two instances of technologies to manage livestock reproduction. All but one of the introductions of new or improved breeds and artificial insemination constituted incremental enhancements to the productivity.
	Animal health and nutrition	Thirteen instances of animal health and nutrition techniques were introduced in 10 countries in four regions. The innovations focused on vaccinations and deworming (six projects) – in particular, large ruminants, but also pigs, sheep and poultry. Other techniques included multinutrient and mineral blocks and other animal health practices (five projects), and other cow-rearing practices (two projects).
	Small animal husbandry	Seven innovations were identified for small animal husbandry across five countries in three regions. Innovations included improved management of small ruminants in *fundo de pasto* (*Fundo de Pasto* communities in the Brazilian semiarid state of Bahia) and improved production methods (with regard to piggeries and goat-and duck-rearing).
	General livestock husbandry	Improved animal husbandry techniques were reported in six instances, without providing further details.
	Beekeeping/sericulture	Improved beekeeping practices included annual bee treatment campaigns to combat the varroa mite, disease control, and modern beehive management. Sericulture was identified in one instance.
	Poultry husbandry	Livestock innovations related to poultry encompassed sand-based mini hatcheries, housing and better feed for chicken, integrated poultry-aquaculture scheme and generally improved production practices.
	Housing	Improved housing for ruminants and poultry for efficient collection of manure, penning of livestock and area enclosure.
	Feeding	Innovations in livestock feeding included stall-feeding, trial of animal feed alternatives (molasses blocks and compound feed) and improved livestock forage technologies.
	Intensification	Intensification of animal production, specifically piggeries.
	Dairy	Improved productive dairy farming referred specifically to milk collection and chilling, basic husbandry, health, breeding/breed selection, and feeds.
Post-harvest and processing	Methods	Technologies included sundried camelid, fodder preservation and pig feed processed from cassava, roots and tubers, including cassava, rice, sweet potato yoghurt/potato chips, fish, tea, beef, honey, butter and cheese, crispy corn (*tengma*), castor oil, fibre weaving nettles, and bamboo chopsticks.

	Tools and equipment	Innovative equipment for post-harvest and processing included *chorkor* ovens for smoking fish improved bakery ovens; *néré* steamers; processing plants for Brazil plum, ouricoury palm, cassava and honey; weaving machines for camelid wool; sisal manufacturing tools; crushing units and fixed threshers for olives, apples and meat; maize mills, bundling machines for *bourgou* conservation; rice-drying technologies and rice huskers; and processing equipment for cassava, onions and forest products (e.g. mushrooms, *chikada*).
	Management	Post-harvest management
	Storage	On-farm grain/bean storage
Land management	Soil conservation/improvement	Soil conservation practices included contour tillage, gully control; construction of crest/infiltration ditches; live fencing/hedge rows; mixed cropping of cactus legumes and millet; use of legumes as cover plants; conservation agriculture and zero tillage; cut-and-curry livestock production; introduction of moringa plantations; introduction of nitrogen-fixing trees in maize-based agroforestry; biological and structural measures to prevent land degradation; and forage-based conservation measures.
	Land use	Innovations in land use mentioned home gardening (in three instances), planting of seedlings to foster local vegetation and regeneration of *bourgou* flood plains.
	Land and pasture management	Improved pasture and land management were mentioned in four instances. Details were provided only for pasture reseeding to improve grazing areas.
	Land preparation	New approaches for land preparation included stubble incorporation.
	NRM (water/watershed/soil)	Methods and technologies for watershed protection, soil and water conservation techniques.
	Agroecology	Implementation of agroecological techniques
Fertilizers and chemicals	Fertilizer use efficiency	Fertilizer use efficiency encompassed: (1) Improved fertilizer use, such as fertilizer use management tools, improved fertilizer use, split use fertilizer, compacted fertilizer, palm tree management practices (fertilizer use). LCC and USG; and (2) introduction of fertilizers, including fodder improvement for cows – phosphate fertilization of fodder – and introduction of fertilizers.
	Pest and weed management	Innovations related to pest and weed management included IPM/WPM practices; biological plant protection; application of biological repellent to animals; and palm tree management practices (specifically mite control, diamond black moth biological control, organic pesticides, and pheromone traps).
	Organic fertilisers	For organic fertilizers, all of the innovations involved composting and included: (a) Introduction of new composting techniques, e.g. vermicomposting and use of composting and animal manure; and (b) promoting improved compost use.
Energy	Biogas	Biogas technologies were mentioned in 10 instances, encompassing the introduction of both biodigesters and biogas units.
	Efficient stoves/wood sources	Improved and eco-efficient stoves were introduced in eight instances.
	Renewable (solar/wind)	Renewable energy sources included mainly solar and wind energy. Solar panels were used to power solar pumps (two instance), solar lanterns (one), for general irrigation purposes (one) and lighting (one). Wind energy was used for irrigation purposes in Nigeria [19], where windmills were used to provide a reliable water supply (one instance).
	Biogas and renewable (solar/wind)	Biogas was combined with alternative energy sources, including solar and wind-powered technologies.

Water	Drip irrigation	Drip irrigation was mentioned seven times. Specific examples referred to an integrated fertilization and irrigation approach, new agricultural technologies for efficient water use and modern pressurized irrigation schemes.
	Harvesting	Innovative water harvesting techniques included the Vallerani mechanized system in microcatchments for higher fodder shrub and fruit tree production, multifunctional boreholes, a submerged solar pumping system, and water-saving home gardens.
	AWD	Alternate wetting and drying (AWD) was mentioned three times: as a water conservation measure, for arsenic load reduction, and as a technology for rice production.
	Small-scale irrigation	Small-scale irrigation technologies included rainwater harvesting for hillside irrigation, manual pump and spate irrigation.
	Drainage	Water drainage was reported in two instances, referring specifically to drainage trenches and water drainage for reuse in irrigation.
	Delivery	Innovations related to water delivery included new irrigation technologies and greywater reuse in agriculture for olive production.
	Drinking	Improved lightweight pitchers were introduced to improve drinking water collection.
	Seawater exclusion	Climate-smart and sustainable strategy to prevent contamination of soils and aquifers by seawater
Fisheries	Fish cultivation and aquaculture	Twelve examples of new fish cultivation and aquaculture activities were identified. Technologies included cage fish culture, trout farming, and prawn catfish culture (five instances), small nutrient-rich fish species (*Amblypharyngodon mola*) to improve human nutrition (one instance); prawn hatchery establishment (hatchery establishment to ease the supply constrain of post-larvae to prawn farmers in floodplains areas (one); crab fattening/hardening (one), paddy field/fish-raising model (one); modern management in pisciculture (one); fish rearing in large fish ponds (one).
	Fishing equipment	Innovations related to fishing equipment included new fishery tools (one instance), navigation equipment (including new gear for offshore fishing) (one) and alternative fishing gears, such as hand lines, long lines and gill nets (one).
	Boat construction	Improved boat-building techniques included solar-powered icemakers and freezer systems, promoting use of ice as a post-capture conservation measure.
Seeds	Production of certified/quality seeds	Certified/quality seeds were introduced for the following crops: rice, groundnut, cowpea, maize, peanut, mung bean and cassava resistant cultivars.
	Multiplication of tubers/seeds	Seed production and multiplication was reported for imported acacia, spiny bitter gourd, onion and potato. Other innovations related to seed multiplication included use of hydroponics and the Maria model for rice seed production and preservation.
Forestry	Agroforestry	Sustainable forest protection programmes and intensive mixed agroforestry systems (including hedgerows).
	Forest nurseries	Forest nurseries were mentioned twice, referring specifically to acacia seedlings in one instance.
	Forest resource harvesting	Innovations related to harvesting forest resources included bamboo and rattan production, as well as harvesting of mushrooms.
	Tree planting	Tree planting was reported in one instance, in Bolivia.
Agricultural tools	Tools	Innovative agricultural tools included camelid shearing machines and ergonomically agricultural tools for drudgery reduction.

	Mechanization	Technologies for farm mechanization included power tillers and motorized wheat threshers.
Other	Environmental services/carbon credit	Payment for environmental services was mentioned twice. Another innovation referred to extracting carbon credit under a Clean Development Mechanism.
	Farming systems	Innovations related to farming systems included integrated farming system models (among which intercropping, new improved varieties of cash and non-cash crops, new approaches for land preparation, integrated drainage and irrigation interventions combined with soil monitoring).
	Dryland agriculture	New technologies for dryland agriculture were introduced, including crops-rangeland-livestock integration in low-rainfall areas.
	Non-land-based activities	Non-land-based activities, including handicrafts.
	Cropping systems	Newly introduced cropping systems, including the use of legumes for soil improvement and the introduction of new crop varieties.
	Climate-resilient technologies	Climate-resilient technologies were introduced in one instance in Zambia.

Key persons met

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Sample for review

Evaluation number	Country	Evaluation product	Year of publication	Evaluation title	Region	IFAD cofinancing (US$ millions)
1	Bangladesh	CSPE	2016	Overall	APR	142
2	Bolivia	CSPE	2015	Overall	LAC	112.7
3	Brazil	CSPE	2015	Overall	LAC	260
4	Cambodia	CSPE	2018	Overall	APR	166.2
5	Cameroon	CSPE	2018	Overall	WCA	84.3
6	China	CSPE	2014	Overall	APR	775
7	Democratic Republic of the Congo	CSPE	2017	Overall	WCA	156.07
8	Egypt	CSPE	2017	Overall	NEN	321.4
9	Ethiopia	CSPE	2016	Overall	ESA	473
10	The Gambia	CSPE	2016	Overall	WCA	73.1
11	Ghana	CSPE	2012	Overall	WCA	225
12	Jordan	CSPE	2014	Overall	NEN	70.5
13	Kenya	CSPE	2011	Overall	ESA	175
14	Madagascar	CSPE	2013	Overall	ESA	175
15	Mali	CSPE	2013	Overall	WCA	183
16	Mozambique	CSPE	2017	Overall	ESA	147.41
17	Nepal	CSPE	2013	Overall	APR	146
18	Nicaragua	CSPE	2017	Overall	LAC	80.64
19	Nigeria	CSPE	2016	Overall	WCA	317.9
20	Rwanda	CSPE	2012	Overall	ESA	150
21	Senegal	CSPE	2014	Overall	WCA	208
22	United Republic of Tanzania	CSPE	2015	Overall	ESA	360
23	Uganda	CSPE	2013	Overall	ESA	294
24	Viet Nam	CSPE	2012	Overall	APR	257
25	Zambia	CSPE	2014	Overall	ESA	188.5
26	n/a	ES	2016	Environment and Natural Resource Management	n/a	n/a
27	n/a	ES	2018	Building Partnerships for Enhanced Development Effectiveness	n/a	n/a
28	n/a	ES	2016	FAO's and IFAD's Engagement in Pastoral Development	n/a	n/a
29	n/a	ES	2017	IFAD's Support to Scaling up of Results	n/a	n/a
30	n/a	ES	2016	Non-lending Activities in the Context of South-South Cooperation	n/a	n/a

Evaluation number	Country	Evaluation product	Year of publication	Evaluation title	Region	IFAD cofinancing (US$ millions)
31	n/a	ES	2014	Water Conservation and Management	n/a	n/a
32	n/a	ES	2014	Rural Youth	n/a	n/a
33	India	IE	2015	Jharkhand-Chhattisgarh Tribal Development Programme	APR	20.8
34	Mozambique	IE	2016	Sofala Bank Artisanal Fisheries Project	ESA	20.2
35	Sri Lanka	IE	2013	Dry Zone Livelihood Support and Partnership Programme	APR	21.9
36	Azerbaijan	PPA_PPE	2013	North-East Development Project	APR	12.5
37	Bangladesh	PPA_PPE	2012	Microfinance and Technical Support Project	APR	16.3
38	Bangladesh	PPA_PPE	2014	Microfinance for Marginal and Small Farmers Project	APR	20
39	Bangladesh	PPA_PPE	2016	Finance for Enterprise Development and Employment Creation Project	APR	35.6
40	Bhutan	PPA_PPE	2014	Agriculture, Marketing and Enterprise Promotion Programme	APR	13.9
41	Brazil	PPA_PPE	2015	Gente de Valor - Rural Communities Development - Project in the Poorest Areas of the State of Bahia	LAC	30
42	Cambodia	PPA_PPE	2012	Community-Based Rural Development Project in Kampong Thom and Kampot	APR	9.9
43	Cambodia	PPA_PPE	2013	Rural Poverty Reduction Project in Prey Veng and Svay Rieng	APR	15.6
44*	**China**	**PPA_PPE**	**2016**	**Environment Conservation and Poverty-reduction Programme in Ningxia and Shanxi**	**APR**	**33.8**
45	Democratic Republic of the Congo	PPA_PPE	2016	Agricultural Rehabilitation Programme in Orientale Province	WCA	14.1
46	Egypt	PPA_PPE	2017	West Noubaria Rural Development Project	NEN	18.4
47	India	PPA_PPE	2015	Livelihoods Improvement Project in the Himalayas	APR	44.6
48	Lao People's Democratic Republic	PPA_PPE	2015	Rural Livelihoods Improvement Programme in Attapeu and Sayabouri	APR	16.1
49	Lao People's Democratic Republic	PPA_PPE	NP	Northern Region Sustainable Livelihoods through the Livestock Development Project	APR	3
50	Lesotho	PPA_PPE	2014	Sustainable Agriculture and Natural Resource Management Programme	ESA	9.8
51	Malawi	PPA_PPE	2017	Rural Livelihoods Support Programme	ESA	14.8

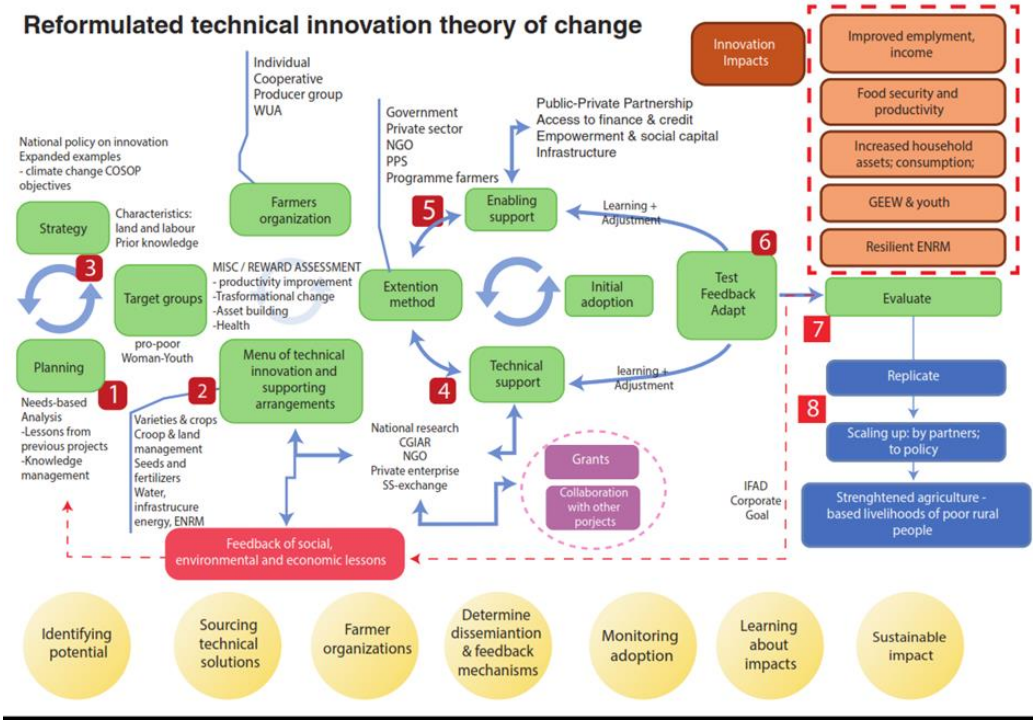
Evaluation number	Country	Evaluation product	Year of publication	Evaluation title	Region	IFAD cofinancing (US$ millions)
52	Mauritania	PPA_PPE	2016	Oasis Sustainable Development Programme	WCA	11.4
53*	**Moldova**	**PPA_PPE**	**2013**	**Rural Business Development Programme**	**NEN**	**14**
54	Morocco	PPA_PPE	2014	Rural Development Project in the Mountain Zones of Al-Haouz Province	NEN	20.4
55	Nicaragua	PPA_PPE	2017	National Agricultural Technology and Training Programme: Technical Assistance Fund	LAC	15
56	Pakistan	PPA_PPE	2015	Community Development Programme	APR	22
57	Rwanda	PPA_PPE	2015	Support Project for the Strategic Plan for the Transformation of Agriculture	ESA	13.9
58	Viet Nam	PPA_PPE	2011	Rural Income Diversification Project in Tuyen Quang Province	APR	23.6
59	Viet Nam	PPA_PPE	2018	Pro-Poor Partnerships for Agroforestry Development Project	APR	21.4

* These evaluation documents were initially included in the sample for analysis; however, they did not report any significant technical innovations.

Theory of change

1. **Theory of change.** The analytical framework for this synthesis was developed around a theory of change (ToC) and a typology of technical innovations. An initial ToC was developed in the approach paper, derived from IFAD's 2007 Innovation Strategy and informed by IOE's 2002 and 2010 CLEs on the capacity to promote innovation and scaling up. The findings in this synthesis allowed for a reassessment of that model and preparation of a ToC that reflects actual practice (see figure 1).

Figure 1
Theory of change



2. Evidence from the evaluations indicates that the ToC has three distinct cycles:

   - to identify the scope;
   - plan the innovations and their dissemination; and
   - provide a supportive framework.

   The change process for technical innovation involves a complex interaction of feedback loops, associated with the adjustment of the technical innovation during piloting, adaptation and learning. While the dotted red line and red box highlight the main feedback loop, the blue arrows indicate interaction, learning and adjustment.

Identifying the scope

3. Interventions must meet farmers' needs, although within the framework of national policies and expected challenges, such as climate change. The COSOP is a source of guidance in establishing direction; lessons from previous projects and experience from IFAD's knowledge management activities help inform choice. Targeting is an iterative process, taking into account the populations IFAD seeks to support, their assets and their existing knowledge. The targeting of innovations may be a subset of wider targeting for the project as a whole.

Planning the innovations

4. Responding to needs, policy frameworks and lessons, one or more technical options can be considered. Many IFAD-promoted innovations will be hybrids of technical

innovation supported by complementary processes and institutional innovations, which may enable or add impact to the technical innovation. At this stage, the nature of the desired change can be identified: to improve productivity; introduce more transformational change; help build individual or community assets; or contribute to improving health. The type of change has a bearing on the assessment of risks faced by the target group.

Dissemination

5. Decisions on dissemination bring together the nature of the technical innovation, the preference or otherwise for working through farmer organizations and the method of extension and dissemination. Many innovations are promoted as part of a combination of practices. The choice of farmer organization may have a direct relationship with the need to empower targeted participants for the innovation.

Enabling support

6. The technical innovation (TI) concept embraces three classes: (1) sole TI; (2) TI + an essential process and institutional innovation for effectiveness of the TI; or (3) TI + an optional complementary process and institutional innovation that magnifies impact of the TI itself. Certain innovations are enabled by access to finance and credit; others are dependent on infrastructure; some benefit from social support to empower participants that might be directly linked to farmer organizations, as noted above. During implementation, there is likely to be a need for continued technical support, which may require a partnership with a research organization or the private sector. South-South exchange has fulfilled that role in certain instances. Grants and direct collaboration with other projects are a way of sourcing this support. The timing of all support is important.

Monitoring and evaluation

7. Far too many innovations are not evaluated properly. Few projects report robust evidence for productivity and farm incomes. There are two desirable cycles in this respect. The first cycle ensures rapid feedback during implementation, so that technology can be modified and dissemination improved. The second cycle seeks to generate convincing evidence for partners to pick up and scale up. Outcomes can be evaluated using standard IOE criteria.

Scaling up, feedback and learning

8. The innovation process may take the form of replicating from one setting to another, often before being scaled up by partners or incorporated into policy. However, there is little evidence that this process is planned and predetermined. Serendipity appears to play a significant role.

9. Learning plays an important role in an effective process. Information from economic, social and environmental outcomes is a consideration in the selection of technical packages and is updated by early results from adoption and periodic evaluation. Evaluations must assess the three decision cycles in this model: matching potential solutions to target groups; the selected implementation package and modalities; and the adoption/adaptation practice.

10. All ToCs rest on assumptions. These are indicated as numbered red boxes in the diagram and are listed here.

Assumptions

1. IFAD is able to source cross-disciplinary lessons and examples relevant to the preferred target group from its own or partner knowledge resources.
2. Planners bring a mix of technical skills and field experience to create adaptable, innovative intervention packages.
3. Innovation process embedded in IFAD’s procedures and decision-making.

4. IFAD staff have autonomy of decision-making to create and finance technical support.
5. Adequately resourced partnerships are created with shared objectives, agreed priorities and supportive policies.
6. Routine monitoring is comprehensive, documenting initial and wider adoption, farmer perceptions, physical and financial returns.
7. Evaluation is planned during project design, with adequate resources where necessary for counterfactual models.
8. Replication is actively promoted to demonstrate effectiveness in other settings and to test the innovation.

Innovation theory

1. Innovation has been defined by Schumpeter (1939) as the introduction of a new production method, new inputs into a production system, a new good or a new attribute of an existing good, or a new organizational structure (Phillips et al., 2013). He clearly distinguishes innovation from research and invention, stating that: "innovation is possible without anything we should identify as invention, and invention does not necessarily induce innovation" (Schumpeter, 1939). IFAD (2007) further explains this distinction, defining innovation as "the dissemination of something new in a given context, not as something new in absolute terms". The World Bank (2010) defines innovation as "means, technologies and practices that are new to a given society. They are not necessarily new, but they are being diffused in that economy or society." More recent definitions have extended this to include "what is used and has resulted in substantial social and or economic benefit to the user" (FAO, 2014).
2. Many reviews of innovation in agriculture refer back to Rogers' "Diffusion of Innovations",[1] in which Rogers characterizes stages of innovation as phases within which individuals participate: innovators, early adopters, late majority adopters, and laggards averse to change (Rogers, 2003). However, this characterization assumes that innovation – taken to mean the adoption of externally introduced technologies – always constitutes progress, that innovations are technology-based, and that they disrupt past ways of conducting business (Joly, 2018).
3. More recent conceptualizations of innovation refer to innovation as a process embedded in local circumstances, based on local knowledge and adaptation, in continuity with the past (Joly, 2018; van der Veen, 2010). The concept of innovation itself derives its meaning from specific contexts and needs. Current discussions of innovations therefore emphasize the benefit to livelihoods and well-being as perceived by stakeholders (Kilelu et al., 2013).
4. With regard to agriculture, innovation has been a major driver of progress (Sunding and Zilberman, 2000). Both process and product innovations have been developed at the farm or individual level, including changes in production processes (e.g. intercropping), the introduction of new crops or varieties, and changes in farm management. The uptake of these innovations generates a wide array of results, including productivity growth, output diversification and drudgery reduction, among others (FAO, 2014). However, in recent times, innovations in the field of agriculture had to take into account major social and environmental challenges to transition to sustainable food systems.
5. It has therefore been recognized that adaptation of an agricultural innovation to local environmental and social conditions is fundamental (van der Veen, 2010).
6. Following this perspective, the adoption of agricultural innovations is therefore linked to the social circumstances of farmers, including household structure, land tenure, size of farms, personal wealth and agency (van der Veen, 2010). While agricultural innovations often address a need to increase food production, frameworks for food security and nutrition recognize that many farmers in resource-constrained conditions tend to prioritize security, stability and flexibility, to ensure their ability to feed their families and minimize risk (FAO, 2006). On a similar note, innovations requiring investments that save labour may not be seen as desirable where labour is more readily available than capital (Dorin, 2017).

[1] First published in 1962, with a fifth edition published in 2003.

Enabling factors for sustainability

Enabling factors

1. The sustainability of technical innovations is linked to the sustainability of the relative enabling factors. Among these, common trends were identified in relation to partnerships, extension services and technical support, marketing and cooperatives and farmer federations. These are discussed in turn.

Partnerships

2. **Partnerships can provide continuity for innovations.** Continuity of partnerships or partners' functions is often a critical requirement for the sustainability of technical innovations [1, 5, 14, 19, 20, 45, 52]. The partners involved included national and international research institutes, private actors and NGOs.

3. In Bangladesh [1], post-project technology support was expected to continue through governmental departments in partnership with local and international research institutes, such as IRRI, the Bangladesh Agricultural Research Institute and the Bangladesh Rice Research Institute. In contrast, the sustainability of rice seed multiplication in Cameroon [5] may be constrained once the project stops financing the seed programme of the Institute of Agricultural Research for Development.

4. **The private sector may, at times, be able to fill a gap in the public sector.** In Madagascar [14], the 2009 political crisis resulted in a decrease in international aid, which in turn limited the replication of innovations. However, partnerships with local and international private enterprises were identified as a source of support for innovations. In Nigeria [19], the sustainability of new or improved crops, as well as of flour production from cassava, was partially driven by private actors. In the Lao People's Democratic Republic [49], the sustainability of livestock vaccination was constrained by a lack of inputs; these are usually distributed by extension officers, who rarely visited the villagers. However, this innovation could not be supported by private actors, because of the limited number of veterinarians available and the lack of cold chambers.

5. The veterinary system introduced by the project to support herd genetic improvement in Rwanda [20] risked being discontinued after project closure, due to withdrawal of service providers (Heifer International and Send a Cow Rwanda, two international NGOs). To ensure the sustainability of the innovation, training of paraveterinarians and the provision of veterinary kits was required.

Extension services and technical assistance

6. **Many innovations need continuing extension and technical assistance services.** The provision of extension services and technical assistance was identified as an enabling factor for the sustainability of several technical innovations [2, 4, 8, 18, 35, 46, 52]. Continuation of technical support after project closure must be assured, perhaps by means of institutional commitments or the willingness of farmers to pay for such services once project subsidies are no longer available [58].

7. Strong demand is a positive driver for the sustainability of multistage seed potato production in Sri Lanka [35]; however, a high-technology approach using hydroponics creates a dependence on scientific and technical support, which could become critical after project closure.

8. The technical assistance provided by the artificial insemination centre in Egypt [46], supporting livestock genetic improvement, was sustainable. The centre covered the majority of its operational costs with service fees, reaching farmers outside the project areas. In Mauritania [52], support for oasis producers was

sustainable, as facilitators reportedly provided services to producers who were no longer supported by the project through the establishment of "producers support associations". On the contrary, a market for technical assistance did not develop in Bolivia [2], despite the provision of resources to pay for such services. However, such incentives terminated upon project completion and some of the most skilled technicians engaged in different activities, further reducing the sustainability of technical support.

Marketing (value-chain approach)

9. **Support to move up the value chain must develop relationships, as well as introduce technology and processes**. As part of a value chain approach, promoting value addition and a shift from subsistence to market agriculture, the sustainability of several technical innovations was linked to the strength of their connection with buyers and markets [2, 3, 11, 23, 35, 42, 58].

10. The sustainability of oil palm, introduced as a cash crop in Uganda [23] as part of a value chain intervention, showed good prospects. The commercial viability of the product, combined with private investment attractiveness and spillover effects to the transport sector and other businesses were among the factors affecting the sustainability of the initiative.

11. Increased market access and growing local demand supported the sustainability of new crop varieties (maize, soybean, aromatic and hybrid rice) and improved breeds promoted in Viet Nam [58]. This was an indicator of an agricultural sector transitioning towards enhanced market linkages and value addition.

12. In Ghana [11], there was a need to identify additional markets if the production of planting materials continued to increase, or the project benefits (in terms of increased income) risked becoming unsustainable. Market connections were also identified as a driver for the sustainability of camelid enterprises in Bolivia [2]. The Peasant Camelid Economy Support Project promoted several innovative interventions, including weaving machines for camelid wool, processing techniques for sun-dried meat and shearing machines. However, the investments in processing of camelid products were not sustainable, because of the lack of a long-term vision and the health registrations required to access more competitive markets.

Cooperatives and farmer federations

13. **Local organizations help farmers share experience and manage risks.** Functioning cooperatives and farmer associations, including those created to implement project activities and foster the adoption of technical innovations, helped members manage innovations and cope with new challenges [5, 8, 20, 46, 55, 58].

14. Cooperatives providing technical assistance for production and marketing enhanced the sustainability of new production techniques in Nicaragua [55]. Similarly, the reseeding of degraded areas in Lesotho [50] proved to be more sustainable on land managed by grazing associations, rather than in open communal grazing areas.

15. In several cases [5, 20, 46], cooperatives and farmer associations were institutionally or financially too weak to foster the long-term adoption of innovations. In Cameroon [5], the sustainability of technical innovations was hindered by the limited capacity of producers' organizations. According to the PCR, less than one third of the producers' organizations supported by the project were able to supply improved inputs, seeds and technical assistance to their members without project support. The cooperatives formed to support the introduction of improved breeds in Rwanda [20] were institutionally and financially weak, and dependent on the project for further support.

16. The few examples illustrate potential in several ways:

- To enhance social capital and self-reliance by means of a combination of technical training, exposure to markets and an appreciation of production and processing quality and standards;
- Stimulating institutional change, at times in recognition of individuals' rights, or to establish a legal framework, such as for the supply of quality seeds.

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