Africa Research in Sustainable Intensification for the Next Generation

Program proposal for a second phase, 2016–2021

Submitted to:
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by the

International Food Policy Research Institute
International Institute of Tropical Agriculture
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www.africa-rising.net

The Africa Research in Sustainable Intensification for the Next Generation (Africa RISING) program comprises three research-for-development projects supported by the United States Agency for International Development as part of the US government's Feed the Future (FTF) initiative.

Through action research and development partnerships, Africa RISING will create opportunities for smallholder farm households to move out of hunger and poverty through sustainably intensified farming systems that improve food, nutrition, and income security, particularly for women and children, and conserve or enhance the natural resource base.

The three projects are led by the International Livestock Research Institute (in the Ethiopian Highlands) and the International Institute of Tropical Agriculture (in West Africa and East and Southern Africa). The International Food Policy Research Institute leads an associated project on monitoring, evaluation, and impact assessment.

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Executive summary

Africa RISING (Africa Research in Sustainable Intensification for the Next Generation) was coined in early 2012 as the collective name for three linked sustainable intensification (SI) projects funded by the United States Agency for International Development as part of the United States government-wide Feed the Future initiative. Initially conceived as three regional projects working in similar ways, inception workshops revealed strong potential synergies as well as opportunities to deliver greater impacts through adoption of consistent approaches and cross-learning through a joint program.

The program operates in Tanzania, Malawi and Zambia (managed by the International Institute for Tropical Agriculture), in Ethiopia (managed by the International Livestock Research Institute), and in Ghana and Mali (managed by IITA). The program's monitoring and evaluation (M&E), data management, and policy research of the regional projects is led by the International Food Policy Research Institute. A small program-level communications project is managed by ILRI on behalf of the partners.

Key elements of the approach taken during phase I included a demand-driven focus to identify entry points for SI with the potential to move to scale; a focus primarily on the household level but not excluding researchable constraints at the landscape level; addressing, in parallel, issues in the wider enabling environment (markets, institutions and policies) through the establishment of broad-based multi-stakeholder platforms.

The three projects comprising Africa RISING were each evaluated in late 2015 and early 2016. The evaluations were generally positive, providing useful feedback, insights and recommendations. Work on this program proposal was initiated in mid-2015 and benefited from interactions with USAID staff in Washington DC (June 2015), engagement with key program stakeholders and partners (October 2015 in Mali), inputs from internal and external evaluators, and project-specific planning meetings in early 2016.

This overall program proposal is an umbrella framework for three regional project proposals, a monitoring and evaluation proposal and a communications proposal to be submitted by the partners.

Purpose and theory of change

The purpose of Africa RISING is to provide pathways out of hunger and poverty for smallholder families through sustainably intensified farming systems that sufficiently improve food, nutrition, and income security, particularly for women and children, and conserve or enhance the natural resource base.

In essence, the program theory of change proposes that the adoption of research-derived innovation directed at the SI of smallholder agricultural production systems allows rural households to make more efficient use of the resources available to them. They can produce more without compromising the needs of future generations. This increased production can translate into a range of livelihood outcomes through improved income flows, better household nutrition and increased human capacity.

If the research conducted accounts for multiple sustainability domains (productive, economic, social, human and environmental), the long-term equity and viability resulting from the SI innovations developed and promoted by Africa RISING will be enhanced. A demand-driven approach, based on long-term engagement with research and development partners, ensures that appropriate SI innovations can ultimately be scaled to receptive and informed beneficiary households.

Vision of success and impact targets

Phase II of Africa RISING has an ambitious but achievable vision of success across the six countries. Collectively, the three projects will engage with almost 25,000 participating research households. Guided by the technical, system and national priorities and the household typologies identified during phase I, the program will work directly with development partners to scale Africa RISING innovations into a further one million households. The evidence base generated through this widespread scaling will help catalyse further partnerships that will put promising technologies and integrated interventions in the hands of millions of target rural people.

As indicated in the diagram and table below, by the end of phase II, Africa RISING expects to conduct further research with 24,401 households (up from approximately 10,000 now) and to scale sustainable innovation technologies to 1,119,438 households through various development partnerships (up from approximately 110,000 now). Co-investment with these development partners for wider uptake and adoption of the program's outputs will generate a 'partnership dividend' that allows a research project like Africa RISING to actually generate impact at scale.

Impact trajectories	2015	2016	2017	2018	2019	2020	2021
Households participating directly in AR research	**6,921**	**10,007**	**12,195**	**14,329**	**16,997**	**20,332**	**24,501**
Households directly engaged in AR development partner activities	**7,967**	**111,413**	**257,625**	**392,190**	**588,149**	**840,365**	**1,119,438**
Total households encompassed in FTF zones of influence	6,148 million	6,715 million	6,901 million	7,088 million	7,274 million	7,460 million	7,647 million

The table and figure above show the numbers of households that Africa RISING will target, directly or indirectly, over the course of the five-year phase II.

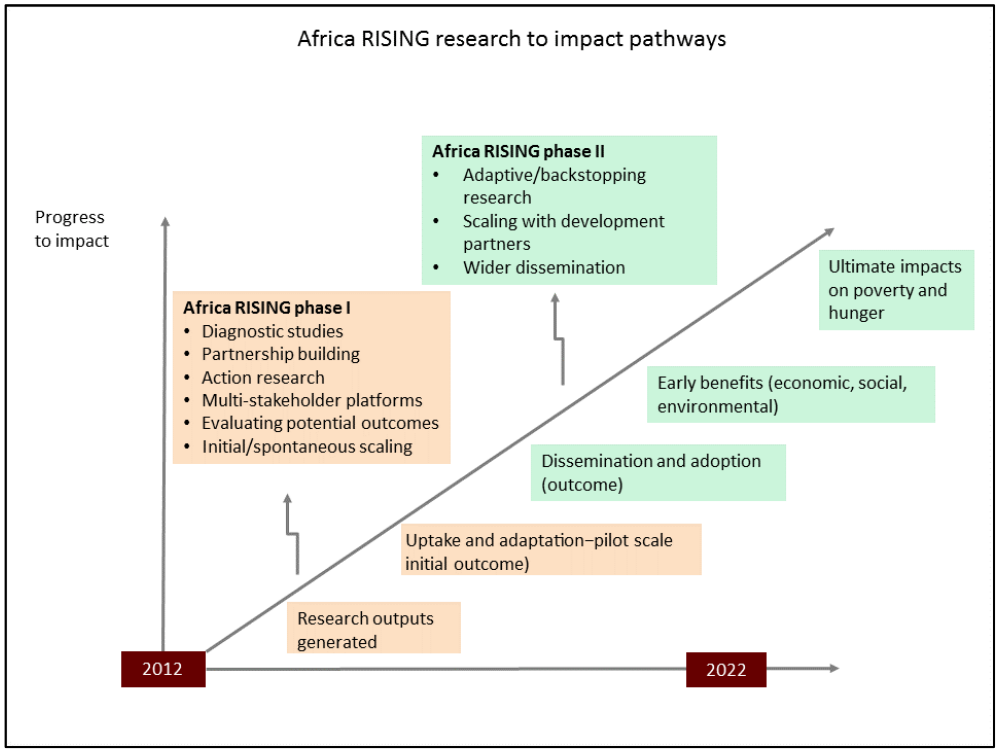
The households that participate directly in Africa RISING research will contribute to the development, testing, validation and refinement of Africa RISING SI innovations. These households also benefit from the program by directly applying Africa RISING innovations. During phase II many more households (the partnership dividend) will adopt Africa RISING innovations through their direct involvement in the activities of development partners and initiatives working with Africa RISING. These development partnerships are a mix of initiatives already started or under negotiation.

It is not feasible in the time frame and budget envelope proposed for a research program like Africa RISING to ensure that its technologies reach all households in the FTF country zones of influence (also shown in the table) nor indeed all other potentially adopting households in a country. However there is considerable scope for third-party additional investments to scale out the program's technologies to reach additional households. Wider dissemination activities during phase II will systematically target such opportunities to enhance the future impacts of SI innovations.

The approach—Moving from phase I to phase II

The phase II proposal mixes continuity with evolutionary change. The action research partners—IITA and ILRI—will continue leading the program, which will retain its geographic focus on Mali, Ghana, Ethiopia, Tanzania, Malawi and Zambia. IFPRI will lead on data management, monitoring and impact assessment. ILRI will continue to lead a communications and knowledge sharing component at program level.

Phase II builds on the diverse strengths and successes of the individual projects using learned lessons, where appropriate, to improve the program's ways of operating (for example in terms of cross-project harmonisation). It will broaden, significantly, engagement with development partners which, backstopped by target Africa RISING research, will be able to generate impact on FTF target indicators at scale through the deployment of Africa RISING innovations (see figure below).



The **program character** of phase II will be further enhanced to ensure that cross-scaling and wider dissemination of research outputs are maximized. This will require a degree of harmonization of the projects, based on the approaches and principles outlined in the umbrella program proposal but implemented as appropriate for each regional project. **Program-wide synergies** will be built around shared analyses, common research questions, coordinated communities of practice and learning supported at the program level by investments in M&E, communications and knowledge sharing, and a light coordination structure.

The **core focus will continue to be on the sustainable intensification** of production from households and systems, with integrated multi-disciplinary research on food security, nutrition, crops, livestock, water, trees, natural resources and markets at the heart. The sustainable intensification framework co-developed by the program in the first phase will be operationalized and used to guide research as well as development interventions. In a nutshell, these interventions aim to improve whole farm productivity, maintain important ecosystem services, and enhance the resilience of farm households to shocks.

Participatory research with different actors in innovation is central to empower and engage development change agents from local communities, governments, extension, the private sector, civil society, universities and research. **Giving priority to women and issues of gender relations** produced good progress in phase I and this will be expanded as part of these innovation systems. Positive experiences with multi-stakeholder platforms and continuing strong farmer engagement in research will be key to this. Phase II will continue to convene and build these up, reaping the dividends of the solid foundations that they provide for collaboration, learning and scaling. **Partnerships beyond the program** with the Feed the Future Sustainable Intensification Innovation Lab, and related projects (CSISA, SIMLESA etc.) will be further strengthened to cross-fertilize science and innovation.

Capacity development will be a crucial and strategic enabler in the complex process of achieving development outcomes through research. Successful capacity development interventions enhance the ability of program staff and partners to contribute to the achievement of key Africa RISING objectives, such as partnerships, scaling results, etc.

Program- and project level **communications and knowledge sharing** activities will place greater emphasis on cross-project and cross-issue exchange and learning to support scaling and spill-overs, and increase dedicated support for communications at program level to deliver more and further.

About the Africa RISING program

The Africa RISING (Africa Research in Sustainable Intensification for the Next Generation) program comprises five component projects focusing on the sustainable intensification (SI) of key agricultural production systems in sub-Saharan Africa:

- Africa RISING in East and Southern Africa operating in Tanzania, Malawi and Zambia and managed by the International Institute for Tropical Agriculture (IITA);
- Africa RISING in the Ethiopian Highlands managed by the International Livestock Research Institute (ILRI);
- Africa RISING in West Africa operating in Ghana and Mali and also managed IITA.
- Monitoring and evaluation (M&E) of these three regional projects is managed by the International Food Policy Research Institute (IFPRI);
- A smaller program-level communications project is managed by ILRI on behalf of the partners.

The **purpose of Africa RISING** is, through action research and development partnerships, to create opportunities for smallholder farm households to move out of hunger and poverty through sustainably intensified farming systems that improve food, nutrition, and income security, particularly for women and children, and conserve or enhance the natural resource base. Operationalizing the SI paradigm is not a simple matter and Africa RISING is breaking new ground in working with multiple stakeholders to address complex and often conflicting issues.

Though not initially planned, very early on, the individual projects began operating under a program umbrella to take advantage of the opportunities for synergies and cross-learning that such a modus operandi would offer. Instead of a formal program management entity, the Program Coordination Team (PCT) is responsible for the strategic direction of Africa RISING and program activities, ensuring a common understanding of core principles, such as SI and its potential contribution to Feed the Future (FTF) goals, and research-related ethics. The PCT also helps to identify opportunities for experience sharing and cross-project support, both informally and through an annual program learning event.

Why sustainable intensification?

With global human population projected to peak at 9.6 billion by 2050 (UN 2012), the question of how to feed so many people is becoming increasingly pertinent. The US-government FTF initiative, along with its partner governments, has been investing globally in finding solutions that strengthen food and nutrition security. The USAID commitment of circa **USD 100 million into research directed** at the wider goals of FTF indicates its appreciation of the need for innovative approaches to such problems.

The SI paradigm (Garnett and Godfray 2012) aims to meet the increasing food and nutrition needs of growing populations through productivity increases, whilst not compromising the well-being of future generations–the sustainability dimension. The approach has been proposed as a key plank of programs, such as FTF, seeking to meet increased food demand from a vulnerable natural resource base under the spectre of climate change and other environmental unintended consequences. However, operationalizing the SI paradigm, i.e. defining adoptable and SI trajectories for specific contexts, is not a simple matter. Multiple stakeholders with diverse and sometimes conflicting objectives have needs that must be accounted for, particularly in order to find sustainable solutions.

Research projects, such as Africa RISING and the other USAID-supported SI projects, are viewed as an appropriate mechanism for addressing these complex issues.

For instance, the original SI paradigm was somewhat narrowly focused on improving production per unit area and achieving this through component interventions. It is becoming increasingly apparent from Africa RISING and other research, that more creative solutions are available by taking a broader view of efficiency of use of other resources (e.g. labour) and by improved management of the trade-offs and synergies operating within food production systems.

The UN (2013) estimates that half of global population growth over the next 34 years (circa 1.3bn people) will be in Africa. In recognition of this, Africa RISING research into food security has been the backbone of FTF efforts to uncover appropriate solutions for the continent. Whilst much of the research completed to date has focused on productivity increases, the inclusion of equity, an enabling environment, and nutritional-quality considerations (among other multiple dimensions of sustainability) has ensured that Africa RISING research has mainstreamed SI into the innovation that it has been promoting in African contexts.

Program vision of success

The Africa RISING phase II vision of success is based upon the premise that project-created innovations fit within certain, specific, contexts. These may be related to market access, agro-ecological conditions, household type, or various combinations thereof. The potential impact of these innovations on FTF goals is determined by these contexts, which, it should be noted, can be expected to evolve during project implementation. The operational activities implemented by Africa RISING phase II and its development partners will seek to influence a set of defined trajectories (see below), within these contexts, in order to move towards the impact targets.

Impact targets

Phase II of Africa RISING has an ambitious but achievable vision of success across the six countries. Collectively, the three projects will engage with almost 25,000 participating research households. Guided by the technical, system and national priorities and the household typologies identified during phase I, the program will work directly with development partners to scale Africa RISING innovations into a further 1 million households. The evidence base generated through this widespread scaling will help catalyse further partnerships that will put promising technologies and integrated interventions in the hands of millions of target rural people.

As indicated below, by the end of phase II, Africa RISING expects to conduct further research with 24,401 households (up from approximately 10,000 now) and to scale sustainable innovation technologies to 1,119,438 households through various development partnerships (up from approximately 110,000 now). Co-investment with these development partners for wider uptake and adoption of the program's outputs will generate a 'partnership dividend' that allows a research project like Africa RISING to actually generate impact at scale.

Figure 1. Target beneficiary numbers for Africa RISING phase II

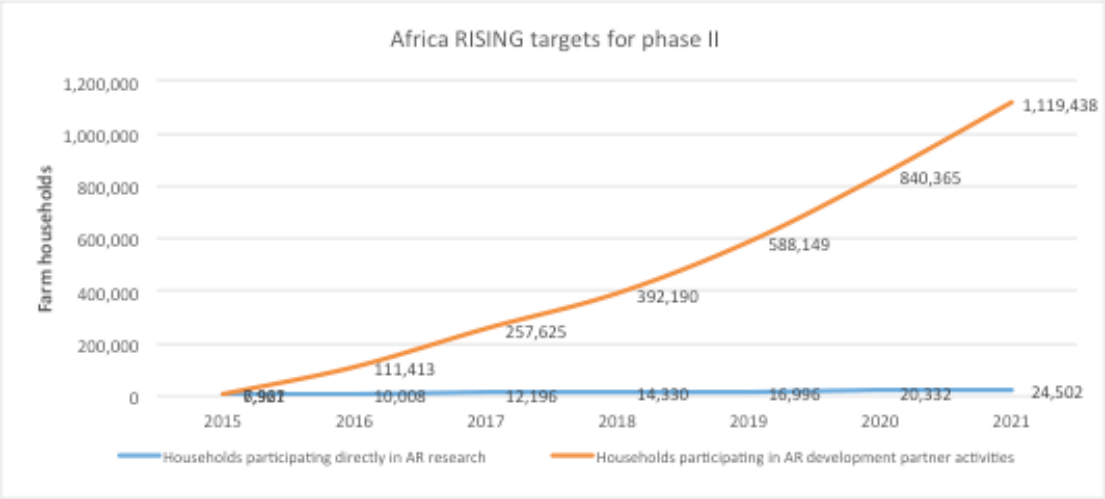


Table 1. Impact targets and progress towards impact (beneficiary households) 2015–2021

Impact targets	2015	2016	2017	2018	2019	2020	2021
Households participating directly in AR research	**6,921**	**10,007**	**12,195**	**14,329**	**16,997**	**20,332**	**24,501**
Ethiopia	961	1,201	1,502	1,877	2,346	2,933	3,666
Mali	1,287	1,609	2,011	2,514	3,142	3,928	4,910
Ghana	1,708	2,135	2,669	3,336	4,170	5,212	6,516
Tanzania	1,659	1,710	1,773	1,852	1,950	2,073	2,228
Malawi	1,306	1,633	2,041	2,551	3,188	3,986	4,982
Zambia		1,720	2,200	2,200	2,200	2,200	2,200
Households participating in AR development partner activities	**7,967**	**111,413**	**257,625**	**392,190**	**588,149**	**840,365**	**1,119,438**
Ethiopia	961	29,015	57,069	147,824	291,579	494,766	729,061
Mali	1287	7521	9401	11,752	14,689	18,362	22,952
Ghana	1708	16,466	21,954	29,272	39,030	52,040	69,387
Tanzania	2705	16,070	82,800	91,080	100,188	110,207	121,227
Malawi	1306	12,796	39,645	65,506	95,907	118,234	130,055
Zambia		29,545	46,756	46,756	46,756	46,756	46,756
Total households in FTF zones of influence	**6,148 million**	**6,715 million**	**6,901 million**	**7,088 million**	**7,274 million**	**7,460 million**	**7,647 million**
Ethiopia	2,693 million	2,760 million	2,827 million	2,895 million	2,962 million	3,029 million	3,096 million
Mali	816,076	842,164	868,252	894,340	920,428	946,516	972,604
Ghana	445,172	455,212	465,252	475,292	485,332	495,373	505,413
Tanzania	1,004 million	1,037 million	1,070 million	1,102 million	1,135 million	1,167 million	1,200 million
Malawi	1,188 million	1,226 million	1,265 million	1,303 million	1,341 million	1,379 million	1,417 million
Zambia		392,893	405,229	417,566	429,903	442,240	454,577

The rationale and assumptions underpinning these numbers are explained in detail in the regional proposals. The three tracks for impact are briefly:

- **Households participating directly in AR research**: The number of households that Africa RISING directly works with to develop, test and validate innovations. These households will benefit by applying SI-related project-generated innovations.
- **Households directly engaged in AR development partner activities**: The number of households that will adopt[1] Africa RISING innovations in close cooperation with development partners and initiatives. These households are direct beneficiaries of Africa RISING, since the SI benefits[2] they experience are attributable to the adoption of project innovations.
- **Total households encompassed in FTF zones of influence:** The number of households aware[3] of and in a position to adopt Africa RISING innovations (where the context is right) within USAID zones of influence. The slight increases reflect population growth. These households may not necessarily experience SI benefits through Africa RISING but through other actors. In these cases, Africa RISING can be

[1] Farmers 'adopt' if they gain access to, test, modify and use an innovation.

[2] Benefits are linked to the five domains of the SI framework. Care is needed so improvement in one dimension does not occur at the cost of other dimensions.

[3] Households that are aware of a certain innovation and able to act on such awareness.

regarded as contributing to the generation of beneficial, livelihoods impacts. The total number of such households cannot be anticipated in advance of phase II.

The partnership dividend: Scaling models for phase II

Different forms of partnership are key to Africa RISING technologies reaching hundreds of thousands of households. These partnerships take different forms suited to local contexts, technology attributes, and investor opportunities. The box below sketches examples of different partnership-based scaling models for Africa RISING phase II.

Scaling through frontline public and NGO delivery systems. In Ethiopia, local, zonal, regional and federal government initiatives are critical drivers for widespread innovation adoption and dissemination. National Agricultural Growth and Growth and Transformation programs (and associated Agricultural Transformation Agency) provide the wider strategy and investment framework for government and development investment. Locally, bureau's and offices of agriculture and livestock, extension and various NGO initiatives drive engagement, dissemination and uptake with communities, cooperatives, and producer groups, as well as facilitating linkages with market actors and co-investors. Already, diverse crop, livestock, land and water management interventions are being tested at wider scales for wider adoption.

Scaling through mission-supported large development initiatives. In Tanzania, Africa RISING and the USAID-funded NAFAKA (Tanzania Staples Value Chain Activity) are collaborating to address persistent constraints to smallholder agriculture productivity and rural well-being by introducing resilient crop varieties, diversifying and increasing community food supply and income sources, and improving degrading smallholder cropland. In this partnership, Africa RISING generates and provides informed innovations and technologies contributing to NAFAKA's aims, while NAFAKA's network of village-based agricultural advisors and farmers' associations, agro-dealers, agro-input companies, and processors provides a platform to transfer and adopt/adapt research outputs.

Scaling through public-private partnerships. The N2Africa project works alongside Africa RISING in several African countries (Ethiopia, Ghana and Tanzania). In each country, Public-Private Partnerships (PPPs) with different legume value chain actors are developed to ensure long-term sustainability of knowledge transfer, legume technology dissemination, efficient input supply chains and access to markets. These multi-stakeholder partnerships are clustered around priority legume crops and geographical areas. Experience in Ethiopia shows how research and private companies work hand in hand to test and develop and then make specific technologies, in this case inoculants, widely available to farmers.

Value created

Working in close partnership with the development community—such as the NAFAKA project in Tanzania—to realize impact at scale from Africa RISING innovations raises questions regarding attribution for value creation. In most circumstances, the development project or program will have its own targets such as the number of households adopting the innovation(s). In such cases, it is proposed that Africa RISING use the same targets, as it will not establish its own dissemination networks.

To avoid double-counting, it is important to define the added value of Africa RISING:

*The value created by Africa RISING equals [the number of households] * (value created per household with Africa RISING engagement – value created per household without Africa RISING engagement)*

Theory of change

A theory of change is a systematic assessment of what needs to happen in order for the desired outcomes of the program to occur. It is designed to explain how and why change happens, as well as the potential role of the work of the organizations involved in contributing to their vision of progress[4].

For Africa RISING, the adoption of research-derived innovations directed at the SI of smallholder agricultural production systems allows rural households to make more efficient use of the resources available to them. Consequently, they can produce more without compromising the needs of future generations. This increased production can translate into a range of livelihood outcomes through improved income flows, better household nutrition, and increased human capacity.

If the research conducted accounts for multiple sustainability domains (productive, economic, social, human and environmental), the long-term equity and viability resulting from the SI innovation, developed and promoted by the Africa RISING program, will be enhanced. A demand-driven approach based on long-term engagement with both research and development partners ensures that appropriate SI innovations will ultimately be scaled to receptive and informed beneficiary households.

Africa RISING will continue to follow a nested theory of change (ToC) adapted to more clearly support phase II of the program. At the top level in the ToC, two distinct types of research are identified with significantly different types of outcomes.

Methodological and diagnostic

Much of the research in this category seeks to reveal the nature of the target systems, and the constraints and opportunities characteristic of these systems. Other generic methodical and diagnostic (M&D) research seeks to understand more clearly and identify potential improvements in the SI processes. Direct SI impacts attributable to this type of research are not anticipated. Its outcomes are more facilitative and the research outputs delivered will help to ensure a more demand-driven[5] focus for the action-oriented research (see below). These outputs will also improve the relevance and targeting of the action-oriented research outputs, improving their adoptability and potential to generate impact. Much of the Africa RISING M&D research has been implemented during phase I, so phase II will not be replicating these broad diagnostic studies which were the focus of the first 18 months of the project. It is likely though that some of the research-in-development (R in D) partnerships at the core of phase II will require specific diagnoses of constraints and a stratification of intended beneficiaries to improve relevance and adoptability of promoted interventions.

Embedded in the M&D section of the theory of change, three major types of M&D research seeking to clarify different key issues relating to SI and the identification of appropriate SI trajectories are distinguished:

[4] From http://www.geofunders.org

[5] Demand-driven: caused or determined by demand from clients or consumers. For Africa RISING, this implies that: (i) demand must be formally identified to drive the program activities, hence the extensive phase I diagnostic activities; (ii) the priorities of any group, including clients and consumers, are not static so an awareness of how demand evolves is built into the program; and (iii) the composition of client groups evolves, necessitating regular demand monitoring.

- **System diagnosis**: this research covers all aspects of the biophysical and social characterization of the target systems and communities for Africa RISING. It includes the identification of researchable constraints and opportunities, and a thematic research prioritization.
- **Trade-off analysis**: conducting systems diagnoses can identify potential solutions for constraint alleviation and promising SI trajectories; however, multiple stakeholders and multiple objectives within households mean that these are always subject to unintended consequences and trade-offs which may outweigh the benefits realised—and will clearly limit adoptability. Formal trade-off analyses allow for the rejection of options compromised by these externalities and/or identification of mitigating measures to strengthen promising interventions.
- **Typologies and equity**: diversity in target groups has two major consequences for SI-related innovations: i) one size does not fit all; most innovations are only adoptable by sub-groups within a target community; and ii) taking a portfolio of SI interventions as a whole, such as that developed by Africa RISING, must ensure equitable access so that all sub-groups have options which are appropriate for them. The use of household typologies, coupled with effective *ex-ante* impact assessment and well-targeted action-oriented research, helps to ensure these principles are met.

Action-oriented

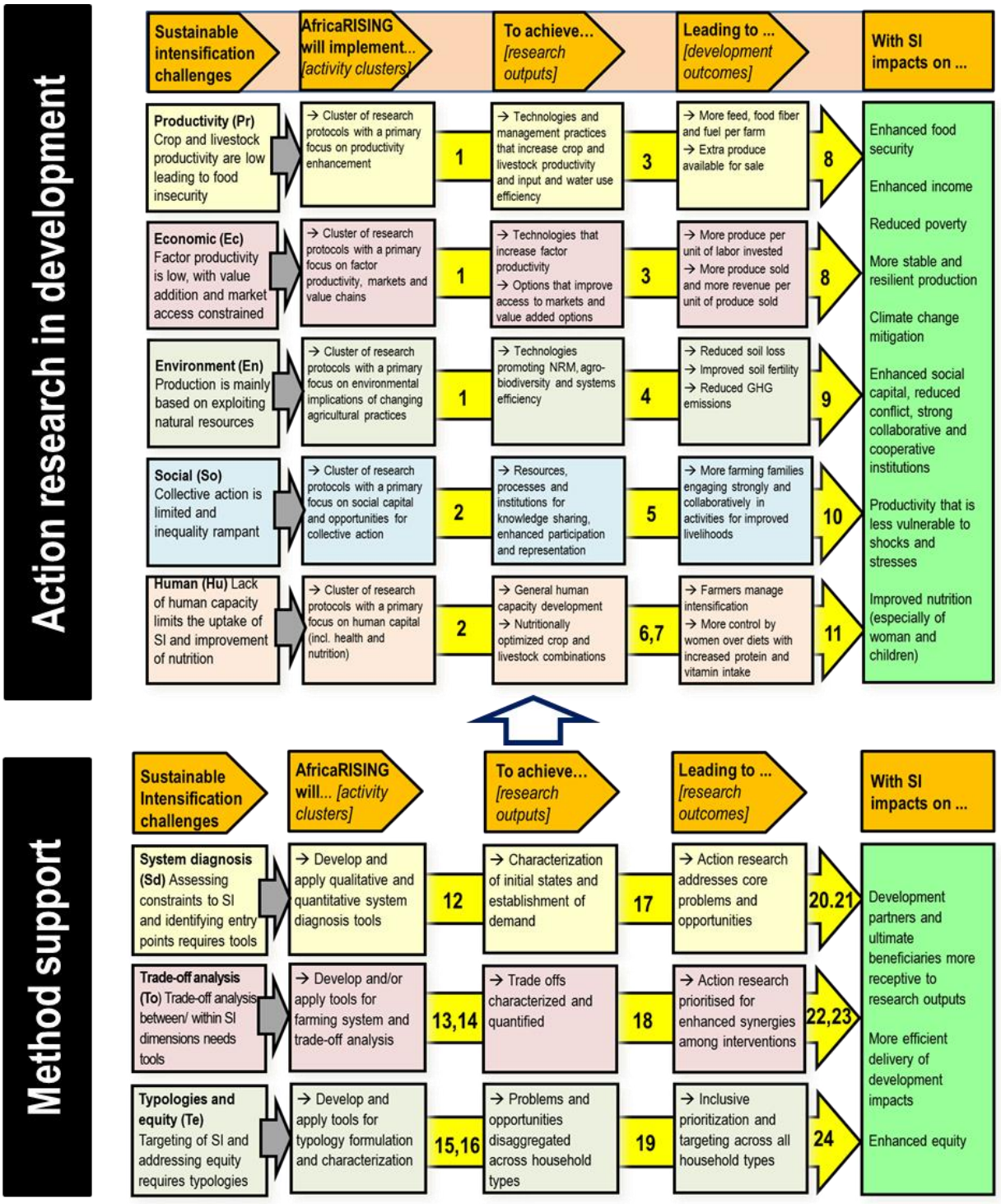
The phase I projects of Africa RISING all implemented broad-based action research—prioritized via the M&D research undertaken—to identify, test and validate interventions/innovations that promote SI and its benefits across multiple domains for stakeholders. This kind of research will continue, to varying degrees, across phase II projects, but will be augmented by action-oriented research specifically linked to development partnerships scaling Africa RISING and associated technologies (i.e. the outputs of phase I).

All Africa RISING action-oriented research is directly linked to developmental impacts in one or more of the five SI domains:

- **Productivity**: interventions targeting the productivity domain seek to promote directly the intensification part of SI with impacts on food security and income;
- **Economic**: research in the economic domain focuses on factor productivity and the value chain function with the ultimate aim of impacting on poverty levels and prevalence;
- **Environmental**: research in this domain needs to identify unintended environmental consequences of innovations promoting productivity and economic wellbeing (in particular), as well as landscape scale interventions to support SI. Targeted impacts include more stable and resilient production, and the mitigation of environmental damage.
- **Social**: the outcomes of research in this domain include strengthening of social capital, and identifying and supporting opportunities for collective action to impact beneficially on social cohesion; and
- **Human**: major elements of the human domain for Africa RISING are the health and nutrition outcomes generated along SI trajectories. These may be targeted both directly and indirectly on the general wellbeing and capacity of individual beneficiaries.

While Africa RISING research activities may primarily target one domain, all are likely to result in outcomes across several domains. This can be beneficial in strengthening adoptability, but also necessitates a clear vision of potential negative trade-offs.

Figure 2. Developmental impact of Africa RISING action-oriented research



Assumptions (A) and risks (R)	
	1. (A) Results of methodological and diagnostic analysis incorrect and/or not considered 2. (A) Adequate quantitative and qualitative databases for social analysis 3. (A) Availability of and access to inputs; functioning markets; technologies and management practices effectively disseminated and adopted 4. (A) Technologies and management practices effectively disseminated and adopted 5. (A) Functioning partnership platforms with adequate stakeholder representation 6. (A) Bio-fortified and diverse crops, plus combinations with livestock lead to increased nutrition; absence of external limiting factors (e.g. bad water, sanitary conditions) 7. (A) Presence of young women attending awareness raising activities; minimum level of women decision making power within a household 8. (A) Absence of other shocks affecting farmers; presence of enabling environment for adoption; level of excess production not distorting market prices 9. (A) Wider adoption of technologies across multiple farmers; farmers' awareness of absence of short-term benefits 10. (A) Social context promoting collective action 11. (A) Adequate and functioning WASH infrastructure 12. (R) Measurement errors, challenges in data collection 13. (R) Incomplete database to address analysis 14. (A) Adequacy of the models 15. (R) Inadequate databases for typologies formulation 16. (A) Typologies reflecting existing farm types 17. (R) Change in demand for technologies due to external factors 18. (R) Researchers embed the trade-off analysis into their research prioritization 19. (R) Missing testing and validation of model findings; errors in interpretation 20. (R) Research outputs and recommendations are attractive to ultimate beneficiaries 21. (A) Uncertainty in buy-in from development partners and ultimate beneficiaries 22. (A) Farmer awareness of risks associated to adoption of innovations 23. (R) Important farmer risk aversion 24. (A) Actual use of typologies by research teams

Moving from phase I to phase II

The projects comprising phase I of the Africa RISING program sought to implement research that would deliver adoptable development solutions. The proposal for phase II aims for this research to drive wider adoption at scale through effective co-working with tangible development partnerships. For this, and other reasons, the proposers do not see Africa RISING phase II as simply a continuation of phase I. It is, rather, an opportunity to implement research that drives development outcomes and documenting evidence for this.

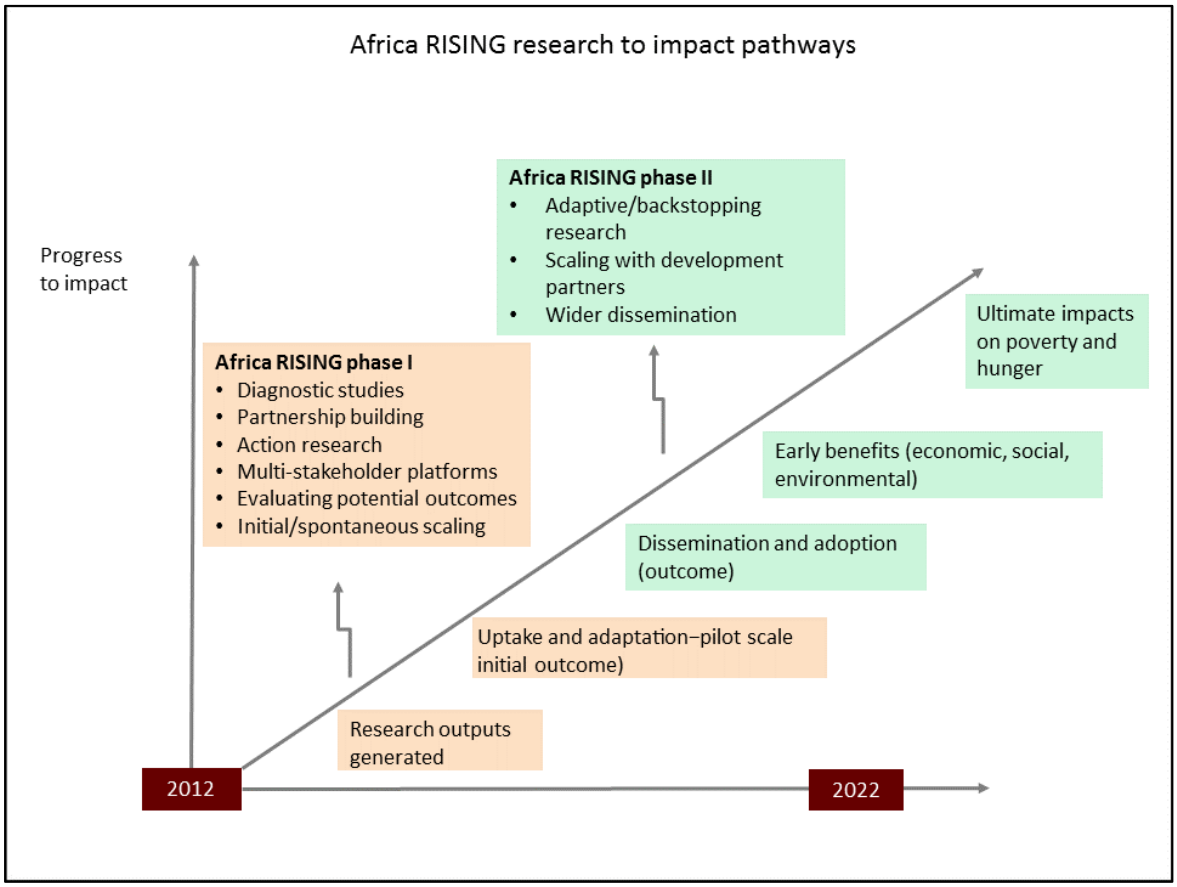


Table 2 illustrates how phase I will evolve into phase II in order to generate wider developmental impacts that are underpinned by credible, relevant and robust research outputs.

Table 2. Evolution of Africa RISING phase I to phase II

Element	Phase I approach	Phase II approach
Research focus	• System diagnosis • Typology identification • Identification of intensification trajectories • On-farm testing/ validation of SI options	• Research to backstop scaling initiatives. • Generic research on systems evolution/ intensification • Application of typologies—analysis, targeting
Monitoring and evaluation	• Monitoring and evaluation undertaken together and centralized within IFPRI • FTF indicators	• Monitoring decentralized to regional teams, while evaluation continues to be undertaken centrally by IFPRI • Strengthen custom indicators in phase II, (e.g. publications)

Research management	● Meetings among regional team only during learning events, and regional review and planning meetings	● More regular (a minimum of two) meetings among chief scientists to harmonize activities and cross learning
Partnerships	● Involvement of more biophysical research partners	● Involvement of more development partners
Capacity building	● No clearly defined capacity building strategies	● Harmonization of capacity building strategies
Multi-stakeholder platforms	● Understanding and establishment of R4D and innovation platforms	● More broad-based R in D approach to multi-stakeholder platforms
Regional harmonization	● Ad-hoc cross-learning and establishment of common approaches ● Program Coordination Team (PCT) provides overall technical and managerial advice and coordination across the three projects	● Program-level development to ensure opportunities for cross-scaling and wider dissemination of research outputs ● PCT to ensure maximum harmonization in approaches and high degree of cross-learning. ● Application of program approaches and principles in all projects and countries
Data management	● Developing data sharing tools	● Partners comply with data management policy and make use of data sharing opportunities ● All data fully accessible
Scaling	● Focus more on action research, less emphasis on deliberate scaling	● Proactive engagement with development partners and public institutions ● Different approaches tested and documented
Communications and knowledge sharing	● Multi-media products with internet, images, video, reports, blog posts ● Process and event facilitation and documentation ● Much '**grey** literature' ● Communicating about the science ● Intra-program and project 'internal' communications and documentation ● Annual learning events and peer visits	● More beneficiary-targeted communication in countries to support technology adoption and scaling ● Communicating 'the' science ● Greater media outreach ● More sophisticated web presence ● Gender-differentiated communication products to address differing abilities and interests ● Regular cross-regional and cross-country exchange visits by researchers ● Program-wide communities of practice around specific topics

Program-level activities in phase II

The attainment of the Africa RISING program level outcomes at scale require increased investment of effort in harnessing learning between the three regional projects. To this end, three mechanisms will be established in phase II: program-wide analyses, program-wide research questions and program-wide communities of practice.

Program-wide analyses

The IFPRI M&E team will undertake program-wide analysis on various aspects of SI interventions. The analysis will be conducted for different audiences and result in various output types, ranging from technical reports to journal articles and briefs. Final decisions regarding the selection of countries has yet to be made. However, Malawi has been selected for participation due to the availability of data from the Africa RISING baseline evaluation surveys (ARBES). Tanzania and Ghana have been selected due to availability of support from skilled staff on the ground. Research topics under consideration (with the indication of countries covered by each study) are:

- **Farming systems, typology, livelihood and poverty characterization analysis** (all countries). This will be a descriptive analysis on household characterization, farm typologies, livelihood strategies using the detailed household and community data collected as part of ARBES.

- ***Ex-ante* and *ex-post* evaluations of Africa RISING innovations** (all countries). In addition to the *ex-post* evaluation, the team will assess the *ex-ante* potential impacts of wide scale adoption of selected SI technologies and management practices across the FTF zones of influence in program countries through:

  1. Crop modelling framework development;
  2. Integrated modelling framework development; and
  3. Case study development and presentation

  The fully developed, calibrated integrated, modelling framework will contribute to support Africa RISING partners in answering research questions on the potential impacts of adopting SI technologies and practices, systemically as compared to the model-estimated counterfactuals.

- **Follow-up evaluation surveys to conduct relevant applied research using panel data identification strategies** (all countries). To assess progress and medium-term program effects, midline evaluation surveys will be undertaken in phase II (2017). Data from these surveys will be combined with baseline data to provide more robust empirical evidence on the agronomic and socioeconomic effects of Africa RISING innovations using panel data identification strategies. IFPRI will collaborate with colleagues to identify and rank SI innovations being tested by analysing relevant socio-economic and spatial data collected by both sets of researchers.

- **Comparative analysis of the return and risk associated with Africa RISING technologies** (Tanzania and Malawi). Considering the Africa RISING focus on finding best-bet technologies, IFPRI plans to analyse productivity and profitability of program technologies. It will analyse net benefits/returns and risks by comparing the cumulative distribution of economic benefits of the Africa RISING technologies. Using trial datasets, IFPRI will also conduct technical and cost efficiency analysis.

- **Determinants and impacts of agricultural technology adoption** (Tanzania and Malawi). IFPRI will analyse the determinants and causal effects of technology

adoption, and explain adoption behaviour by investigating heterogeneous returns to adoption under self-selection. The study seeks to understand if households come the decision to adopt agricultural inputs simultaneously or sequentially, to understand the optimal path of adoption.

- **Technology diffusion and scale-up** (countries to be determined at a later date). Using spatially explicit biophysical and socioeconomic data available in-house, the IFPRI team will assess the representativeness of Africa RISING communities to the FTF zones of influence. The analysis will involve both *ex-ante* and *ex-post* evaluation and will generate evidence on what would happen if current Africa RISING technologies were scaled up within the FTF zones of influence. The M&E team will study the spatial diffusion of the Africa RISING innovations being tested, and eventually scaled up, taking the statistical representativeness of these communities into account. The analysis will take advantage of nationally-representative household surveys to construct synthetic cohorts of households similar to Africa RISING beneficiary farmers. The effects on productivity, income, poverty, nutrition, and the environment will be assessed.

- **Characterizing adopters of sustainable intensification innovations** (Malawi and Tanzania). Using geographic information systems and household survey data, the M&E team will examine the characteristics of villages and households targeted by the program and compare them with non-program villages and households randomly selected from the general population and assess implications for scaling up.

- **Targeted case studies and experiments to guide new research streams** (Tanzania and other countries to be determined at a later date). Willingness to pay studies will offer important market information that would shed light on the acceptance of technologies by farmers and help in assessing the sustainable adoption of Africa-RISING-supported technologies. IFPRI will undertake targeted case studies and experiments to elicit farmers' willingness to pay for SI innovations, examine the determinants of their adoption, and improve understanding of the heterogeneity in farmer demand for these innovations. These case studies will follow the Cereal Systems Initiative for South Asia model, where significant advances have been made in the analysis of demand for specific innovation mixes.

- **Risk rationing, access to credit, and the adoption of agricultural technologies** (Tanzania). Risk preferences and access to credit are among the factors found to inhibit the adoption rate of technologies (such as seed, fertilizer) deemed profitable by their promoters. To examine this linkage further, and based on an ongoing case study in the Babati district of Tanzania, IFPRI will estimate the elasticities of households' demand for credit. Specifically, IFPRI will investigate the typology and prevalence of credit rationing—including risk rationing—analyse the determinants of each typology of credit rationing behaviour, and evaluate the impact of credit constraints (including risk rationing) on agricultural productivity and other outcome variables of farm households.

- **Targeting, bias and expected impact of complex innovations** (Malawi). Researchers, policymakers and donors are involved in SI programs that rely on studies conducted on selected groups of farmers—typically those more likely to successfully adopt the proposed technologies for a sustained period of time. This approach potentially opens the door to serious biases and provides a poor basis with which to assess the prospects for large-scale replications across a wider population of farmers. Yet the

complex nature of these technologies—and the projects promoting them—often conflicts with the use of randomized controlled trials that address sample selection bias. To overcome this limitation, IFPRI will use a quasi-experimental approach integrated with data from geographic information systems to evaluate the Africa RISING project in Malawi testing complex systems-based technologies aimed at improving whole-farm productivity, livelihoods, and food security.

- **Bio-economic modelling of household farm production and its linkages to the environment** (Malawi and other countries to be determined at a later date). The IFPRI team, together with key partners at the Institute for Advanced Studies of Agronomy in the Mediterranean, will develop a new dynamic, household-farm bio-economic simulation model, DAHBSIM. Using DAHBSIM, IFPRI will assess the responses of farm households to different scenarios of agricultural and environmental policy changes and technological innovations, as well as their associated economic, ecological and consumption impacts. Those scenarios will include a combination of individual or combined effects of two main types of driving forces:

    - socio-economic, policy and market changes (e.g. prices of inputs and outputs, availability of land and labour, agricultural and water policies); and

    - with or without alternative technology options (e.g. innovations believed to be suitable for the local production systems such as new maize varieties, improved maize fertilization, conservation agriculture, rotation with forage and food legumes, agroforestry).

    With DAHBSIM those scenarios will be evaluated and compared by calculating multiple sets of indicators—economic (e.g. farm income, total cost, labour cost); social (e.g. total labour by task, female labour, hired labour); environmental (e.g. soil fertility, soil water content, water stress); and nutritional (e.g. total consumption, total protein, consumption by product)—of the sustainability and multi-functionality of agricultural systems, policies, and innovations to enable trade-off analysis. This bio-economic modelling effort will provide another way of undertaking *ex ante* evaluations of various technologies and powerful synergies between the evaluation work being conducted by both teams.

- **Assessing farm-level trade-offs between organic and inorganic nitrogen fertilizers** (Malawi). Using Africa RISING data from Malawi as a case study, this research will combine crop modelling, Decision Support System for Agrotechnology Transfer (DSSAT), and economic analysis to provide empirical evidence on the following topics:

    - the least cost method to produce a fixed quantity of maize or obtain a specific profit;
    - how changes in the costs of fertilizers and organic materials change the input mix;
    - the degree of complementarity between organic and mineral nitrogen;
    - the sensitivity of input mix to changes in rainfall and soil type;
    - the environmental benefits of organic systems; and
    - whether more organic systems can reduce yield variability or down side risk.

    Once results using the Malawi survey data to calibrate DSSAT simulations at the pixel level are available, similar work is expected to be conducted in other Africa RISING countries.

- **Africa RISING as a nutrition-sensitive agricultural intervention** (Malawi and Ghana, and other countries to be determined at a later date). Food and nutrition security are important outcomes that can be supported by the sustainable intensification of agriculture. Using both production and consumption data from ARBES, the IFPRI M&E team will examine the relationship between intensification and household nutrition. In particular, the research will focus on the link between crop diversity and dietary quality, measured in terms of the quantity and nutrient content of food consumed. As food and nutrition security are associated with dietary quality and diversity, the team will also investigate whether crop diversity and productivity translate into dietary diversity, and how effective these two strategies comparatively are.
- **Assessing the interdependence between land use and land cover changes and welfare** (Ghana). This study will examine the interdependence between land cover changes and welfare combining data from household surveys, remote sensing, and the satellite imagery of tracts of land worked by Africa RISING beneficiaries. The fact that the incidence of poverty tends to be spatially concentrated where production systems are vulnerable to land degradation already suggests a correlation between the two. A careful examination of the potentially different trajectories of land cover and poverty is crucial further analysis of the causality mechanism and the sustainable use of land. Using ARBES data collected in northern Ghana, this study will examine the dynamics of land cover changes over the last two decades, assess the independent effects of land cover trajectories on poverty conditions (controlling for other confounding factors), and examine how different biophysical and socioeconomic factors mediate the interdependence between land cover changes and welfare level.

Program-wide research questions

Program-wide Africa RISING research questions focus on the identification and validation of interventions towards SI. These interventions aim at improving whole farm productivity while maintaining important ecosystem services, and enhancing resilience of the farm household to shocks. While the productivity of a specific area comprises the sum of the productivity of all the fields and animals of all farms in the area, the management of certain ecosystem services happens at a level beyond a single plot or farm. Economic considerations are thereby as important as agronomic benefits. Within Africa RISING, various interventions address aspects of productivity, natural resource management, and profitability at field, farm, and landscape scale. Farming systems, agro-ecological conditions, and natural resource vulnerability vary widely across the Africa RISING intervention areas.

SI also encompasses social and human dimensions that will facilitate the uptake of interventions addressing its major attributes. Social capital facilitates the delivery of ecosystem services operating beyond a single household, while human capital ensures that knowledge and skills are present to engage with such interventions. Poverty and inequity, which operate at the interface between social and human dimensions, can prevent the uptake of SI interventions at scale. Across various Africa RISING target areas, the status of human and social capital varies considerably, even within villages or other operational units, as exemplified by farmer typologies.

Enabling conditions are those context variables that facilitate the uptake of SI interventions at scale. Obvious examples include agro-ecological potential, profitable and timely access to agro-inputs and/or credit, access to produce and value added markets, effectiveness of the

extension systems, or facilitating policies. Across Africa RISING target sites, enabling conditions vary drastically and even within a specific country, some enabling conditions vary considerably, e.g. access to markets.

The overall goal of Africa RISING and the gradients in enabling conditions across the various target areas of the program provide unique opportunities for the development of relevant program-wide research questions that will not only assist the program in delivering on its research and development outcomes but also the wider R4D community engaged in developing and scaling SI interventions.

Research questions in the context of SI interventions
The following research questions respond to above justification and build on the research questions and hypotheses addressed in Africa RISING phase I.

1. Trade-offs and synergies: What are the environmental, economic, human and social consequences (according to the SI framework) of productivity-enhancing interventions? And what are the productivity-enhancing consequences (according to the SI framework of environmental-, economic-, human- and social-enhancing interventions)?
2. Adaptation/ adoptability: How are these interventions aiming at increasing productivity and environmental conditions adapted to the endowments of diverse farmer typologies in the target areas and how do enabling conditions (e.g. access to markets, agro-inputs, finance) affect this adaptation process?
3. Livelihoods: How do changes in the management of specific activities or combination of activities within a farm (e.g. a field or a livestock unit) affect overall livelihood conditions for different farmer typologies?
4. Enabling: How do enabling conditions affect the nature (variety, agro-inputs, complexity, diversity) of promising interventions moving towards SI?
5. Equity: How does social capital affect community productivity, cooperation and well-being along with the scaling of SI innovations?

Program-wide communities of practice

Across the three Africa RISING regions, different scientists have undertaken research in response to similar constraints in small farming systems. However, despite annual learning events and several cross-country exchanges, many scientists had limited opportunities to exchange ideas and results in depth with peers in the other regional projects. The program has an urgent need to link and connect and capitalize on the expertise and knowledge spread across the countries and partners. There is also demand for greater harmonization and consistency in approaches and science.

Communities of practice (CoP) are widely-used in development as mechanisms to bring scattered people—who share an interest—together. Keys to success are that a community has a clear focus that strongly attracts and interests people to contribute; that it has some deliverables; that it has some incentives or rewards; and that it is facilitated in some way. They are typically virtual, though some face-to-face interactions often energize more active involvement.

For phase II, the program will set up several focused CoPs in areas like nutrition, livestock, soil and water management, and other priority themes where cross-fertilization and learning is desirable. Technologies applicable to several locations could also be good candidates as the CoPs can act as program-wide innovation testing and adaptation spaces. Other

candidate CoP topics are cross-cutting issues such as scaling, gender, data management, communications and capacity development where some greater consistency is desirable and can be tasked to CoPs.

This approach needs facilitation support and close linking to other activities as experience with CoPs shows that such efforts do not thrive without support. It is desirable to link them to the wider communication and knowledge sharing agenda comprising annual learning events, scientific field trips and exchanges, annual planning and review meetings, and other scientific get-togethers. It may also be desirable to formally associate science leaders in different areas with supporting CoPs to combine both collaboration with standard setting and science leadership.

This learning and sharing agenda will be worked out early in phase II as a deliberate approach to improve program-wide learning, knowledge sharing, program harmonization, science leadership and technology spill-overs.

Engagement

The R in D program, Africa RISING, seeks to provide pathways out of poverty for smallholder farmer households through sustainably intensified farming systems that improve food, nutrition, income security, particularly for women and children, and conserve or enhance the natural resource base. SI–delivered through five mutually reinforcing domains of productivity, economics, environment, human condition (nutrition, food security, and capacity), social and environment–comprises the technical framework required meet this objective. The program has been implemented via a network of partners, constituting its 'R in D' community of practice in West, Eastern and Southern Africa, and the Ethiopian highlands.

In phase I, participatory research approaches were used to engage farmers and a broad range of stakeholders—national research institutes, civil society, the private sector, international organizations and policymakers. Stakeholder engagement was used to identify and clarify research problems, implement the research and learning agenda, and provide feedback to stakeholders, albeit with major focus on farmers. A key lesson learned in phase I was that collaboration and partnerships, among institutions and with individuals, carry risk. Partnerships require time, pooling of resources, formal memoranda, risk sharing, and shared management. These issues permeate through the life of any collaboration, from need identification to implementation, risk management and exit.

In phase II, the program will ensure partnerships are well facilitated in a manner that engenders mutual accountability and effectiveness. Participatory approaches will underpin the R in D agenda: in planning, priority setting, execution and mutual learning involving different stakeholders and farmers. This will ensure farmers and stakeholders (partners) are not overburdened by research activities; and their knowledge, experiences and resources will be leveraged.

The program will also equip partners with skills, knowledge and technologies to improve their productivity and operations. These investments will underpin program knowledge and technology dissemination, and learning network. The strategy will minimize redundancies, add value, and leverage opportunities with partners and complimentary projects to create solutions to common problems in Africa RISING zones of influence. The innovation platforms will remain the critical institutions for engaging stakeholders. A framework and standards to guide partnership formation and management has been developed to strengthen demand-driven research and impact (see Annex 5).

Partnership arrangements

For the program to achieve this, it needs to rely on a wide range of R in D partnerships. Through its participatory research approaches, the program has developed a number of solid partnerships with a range of conventional stakeholders in R in D collaborations, however, limited partnership arrangements have been established with development partners. In phase II, the program will explore how strong partnerships can be established with development partners, allowing for the scaling up of some phase I achievements to reach a large number of beneficiary households in the target sites along value chains. This requires exploring new partnerships and defining roles and modalities of working.

Selecting partners and defining their roles

Selecting partners and defining their roles will be a major feature of the preparation for phase II and beyond, especially non-research partners. The program will position itself to be become a supportive and sometimes catalytic component of collaborations for scaling up innovations. The objectives will inform criteria for selecting the strategic partners that will implement or complement the program or with which the program will seek to align to translate research outputs into development outcomes. The partner types play a large range of roles which will evolve according to the needs of the research and development processes.

Scaling

Increasing the impact and reach of Africa RISING work, from hundreds to thousands of farmers–referred to as scaling out, requires new approaches and partnerships. For instance, partnerships with: development agencies or initiatives that aim to take technologies to scale; public and private extension services; and a range of value chain actors. Scaling out–also requiring consideration of market demand–is, therefore, an opportunity to create space for the private sector. Scaling up–influencing the enabling environment for successful adoption of the interventions–requires engagement with government and policymakers.

The appropriate models for scaling are both context specific and defined by the technologies to be scaled. The approaches for scaling singular component technologies (e.g. improved germplasm) as compared with knowledge intensive models, where the integration of components or farming system changes are promoted, are necessarily different. With Africa RISING largely focused on concepts of SI–a set of processes or a combination of technologies leading to overall system benefits–scaling knowledge-intensive technological changes is therefore the main challenge. It also presents a huge opportunity for science to inform this design for better outcomes.

Fundamental to scaling are:

1. Social engineering and community-exposure to new practices and market opportunities.
2. Demonstrations and action research to contextualize the interventions.
3. Local champions or lead farmers.
4. Consideration of the market opportunities for input requirement and produce.
5. Enhancing capacity in the NARS and public/private sector partners.
6. The role of the private sector.

In pilot scaling projects, such as in phase I, components 1–3 have become important, (see Annex 2 for a summary of this scaling work stream).

Selecting technologies for scaling

The broad terms guiding the generation and selection of scalable technologies are presented in the Africa RISING phase 1 program framework which states, as one of its outputs, that it will generate integrated technology combinations effectively targeted to farmers' real development needs. The technologies or technology components seek productivity enhancement, natural resource management, income generation, knowledge management and most likely a combination of these; and they should also take account of social and institutional arrangements.

No specific practical guidelines were developed to identify scalable innovations; however, over the last four years, researchers have defined best-bet technologies as those which have contributed positively to the physical (e.g. increase in yield), economic, nutritional and environmental attributes of the technology. Scientific rigour has been ensured by testing a technology on a number of mother and baby sites in defined agro-ecologies, and by gathering feedback from interested beneficiary groups. These definitions continue to be used in the development of technologies for scaling and will be complemented by the, now ongoing, development of more defined SI indicators.

Scaling pathways

Scaling successful development interventions is critical to the achievement of the Sustainable Development Goals (SDGs) in sub-Saharan Africa and essential gains in agricultural productivity, rural incomes, and food and nutrition security. The scaling of new technologies, practices, and/or innovations is designed to stimulate wider scale change, not only to the target farming households and their communities, but also in government policy, operational modalities, and institutional set-up and structure. Not an end in itself, scaling is an instrument to achieve the goal of improved livelihoods for the greatest number of people in the broadest variety of geographical settings.

Two types of scaling approaches could be adopted. Horizontal scaling, also known as scaling-out, targeting more people both in existing and newly targeted districts, refers to farmer-to-farmer and community-to-community exchange of technologies, with or without the engagement of external actors. Vertical scaling, also known as scaling-up, refers to the hierarchical institutional integration and partnership, fostered to reach large numbers of people and geographical areas. For successful scaling-up, locally-proven best practices and innovations are essential. Though the program in the different countries is at various stages, Africa RISING has been experimenting on scaling-out technologies and practices that could be promoted to scale-up to influence policy and national planning.

Scaling approaches

Identifying successful approaches to scaling innovation in an R in D project is highly dependent on a number of factors related to the new technologies (crop varieties versus complex NRM- and livestock-related technologies) and management practices, the nature of the farming systems, social and cultural factors, and the wider enabling environment (markets, other institutions and policies). Ideally, scaling activities are tightly embedded in projects and emerge with close links to other activities and with the close involvement of partners. There are no recipes for successful scaling.

However, in the context of Africa RISING, the projects have been able to identify some useful principles and practices likely to contribute–either individually or more likely in combination–to the effective scaling of their more promising innovations. Field days, expert training, farmer-to-farmer knowledge exchange, the establishment and strengthening of local institutions, the mobilization of development partners, the introduction of service provider models, engagement through innovation platforms, and exchange of seed and other planting materials can be some of the approaches used for scaling technologies and practices.

One strength of Africa RISING has been the committed involvement of its local development partners from an early stage of the program. To date, these partners have enriched its research planning with a development perspective. As scaling activities are strengthened, their role will be critical in ensuring successful adoption by more farmers than otherwise expected. Africa RISING will continue looking to engage with the private sector and NGOs, where its innovation platforms can be hugely effective, (see Annex 3 for examples of scaling approaches for crop and livestock technologies).

Enabling environments for scaling

Successful scaling of SI options requires an enabling biophysical (climate, soil, rainfall, temperature, etc.) and socio-economic (policies, institutions, markets, gender, etc.) environment. Multi-stakeholder public–private sector partnerships—involving community-

based organizations, researchers, market actors, policymakers and development agents—will be established to create an enabling environment for vertical and horizontal scaling of technologies/practices. Joint activities will be undertaken with appropriate partners to: share information, identify scalable SI options, develop scaling scenarios, and target scalable options using geographic information systems and remote sensing and modelling tools to reach out to a large number of beneficiaries.

Scaling and delivery options used in past projects will be reviewed to identify appropriate pathways to enhance information flows among farmers—men and women—and among communities. The effect of national and local policy and institutional arrangements, social norms and rules, gender and markets on reaching out to beneficiaries and on the adoption of SI options/practices will be evaluated. Community discussions, field schools, technology parks, and farmer-to-farmer joint learning and exchange visits will be used to enhance farmer capacity to facilitate reaching out to a large number of beneficiaries and wide scale adoption of technologies.

Research on scaling

There is currently little systematic research on evaluating alternative dissemination and scaling up models, and designing institutional innovations that achieve sustainable scaling outcomes from the uptake of SI interventions. Phase II offers the team an opportunity to work with others in a community of practice across the CGIAR Research Programs (CRPs)—as the Maize and Livestock Agri-Food systems CRPs—and with other partners to develop and validate scaling models that will facilitate the uptake of SI interventions.

Gender

Gender cuts across all the research outputs of Africa RISING. It comprises several core elements: gender analysis**; integrated systems improvement; monitoring and evaluation; scaling and gender capacity.**

Gender analysis

Men's and women's varying opportunities and livelihoods in agriculture relate to intra-household differences in access to and control over resources such as land and labour. Unequal decision-making power among household members may affect a number of important outcomes such as nutrition. Africa RISING seeks to improve the income and food security of particularly women and children and therefore takes interest in the gendered distribution of resources and responsibilities in households and how this allocation could interact with its activities. A focus on the household alone, however, may not suffice to support transformation, since gender norms are often reinforced and perpetuated by rules of other institutions such as the community, markets or the state (Kabeer 1994)[6]. Africa RISING therefore aims to combine gender analysis of intra-household resource allocation with an analysis of the gendered effects of other institutions.

In **Ethiopia**, Mulema and Damtew (forthcoming 2016[7]) employ a community capital framework to provide a holistic perspective of the stock and interaction between the different forms of capital required by men and women farmers to effectively engage in agricultural intensification. Despite having a relatively equitable distribution of land, women are hindered from participating in decision-making and lack control over assets.

Female-headed household have smaller farms, less livestock, and limited access to manure for soil fertility management and the adoption of new practices. Overall, women work longer hours, on average, two hours more than men. There are gender differences in role and responsibilities with women being more active in production and less in other nodes of the value chains. The burden of domestic responsibilities legitimizes women´s lack of mobility. Their contributions to crop and livestock production tends to occur close to the homestead so they can fulfil their gender roles. Due to cultural norms and other contextual factors, there are discrepancies in access to information, extension services, inputs and credit, and women are less likely to be members of farmer organizations than men. Lack of information and knowledge is, in part, linked to lower levels of education and literacy among women, inappropriate extension and technology dissemination mechanisms targeted mainly at men or with technologies that are a poor fit for women.

Addressing these inequalities in the agricultural sector will require a transformation of gender constraining norms and gender capacity development of extension workers and researchers. A recent assessment in Ethiopia[8] revealed the poor gender capacities of research and development actors. Attainment of the gender equality goal within the agricultural sector will be impossible without sufficient staff capacities to integrate gender within agricultural research and development.

[6]Kabeer, N. 1994. Reversed realities: gender hierarchies in development thought. Verso, London.
[7] Mulema, A.A. and Damtew, E. (forthcoming) Characterization of gender-based constraints and opportunities to agricultural intensification in Ethiopia: A systematic literature review. Nairobi, Kenya: ILRI.
[8] Mulema, A.A., Tafesse, S., and Kinati, W. 2015. Gender capacity assessment report of Ethiopia small ruminant value chain research and development partners. Nairobi, Kenya: ILRI.

Development and mobilization of social capital is vital for women to access agricultural information, develop and deploy their entrepreneurial skills and accumulate other resources required to adopt intensification practices. Approaches such as innovation platforms, and women-only research groups have the potential to boost women's capital. However, increasing access to resources alone is not enough, women need greater returns from their investment and control over the benefits.

Gender-specific constraints affecting technology adoption and sustainable intensification are not well documented, inhibiting the design of gender-appropriate technological combinations and adoption. There is little gender-disaggregated data related to ownership of assets and the allocation of labour at different stages of intensification. Available literature does not cover all regions, impeding comparisons and assessments of trends across the different forms of capital measured.

More research is needed to:

- Understand the trends in labour allocation as more technologies or practices are adopted, the trade-offs and the effects on household welfare.
- Examine the effects of cultural norms on technology adoption and women's agency, as well mechanization in different farming systems in Ethiopia in order to inform policy and future interventions.
- Assess women farmers' access to credit from formal institutions and control of credit within households.

In West and East and Southern Africa, the gender component received limited attention in phase I but picked up later with staff coming on board in 2015. A broad qualitative gender evaluation of Africa RISING communities in northern Ghana based on the above-mentioned approach of gender and institutional analysis was recently completed and will feed into planning for phase II. A similar consultancy will be launched in September 2016 for Malawi to inform upcoming activities in the target communities. Since both investigations use the same methodology and research questions, a cross-regional comparison between Ghana and Malawi will sharpen insights into the suitability and gender-responsiveness of Africa RISING technologies. In Tanzania and Mali smaller gender studies have been conducted (e.g. on mechanization, value chains). A gender action plan, developed for 2015/2016, captures various project activities, also in the field of communications where guidelines for gender-sensitive reporting will be published later this year.

The Africa RISING qualitative gender analysis in **Ghana** (Britwum and Akorsu 2016) confirmed the gendered allocation of crops. Men tend to control the cultivation of staple crops (such as millet and sorghum), cash crops (such as cocoa and yam), and the resulting income, while women bear responsibility for soup ingredients and vegetables. However, Africa RISING data reveals that newly introduced maize is neither allocated to men nor women, offering women farmers an opportunity to grow a staple crop and reduce their dependency on male provision. This entry point for an empowerment of women will be carefully considered in planning for phase II.

In terms of labour, female farmers typically bear multiple burdens: responsibility for domestic chores and support their husbands' cropping activities—at least in male-headed households—before taking care of their own often smaller and poorer quality fields and home gardens. Africa RISING data reveals that women use ox-ploughs, not only reducing their labour, but also creating opportunities to transgress gendered crop allocation norms.

More research is needed to further validate these results and make use of them in Africa RISING interventions.

Customary laws limit women's access to and control over land, leaving most land use decisions in the hands of men. The agency and performance of female farmers in Ghana is further undermined by difficulties in accessing credit, productive resources (e.g. labour, agricultural implements), extension services, and relevant agricultural training. Therefore, Africa RISING phase II will focus on reorganizing its cooperation with Ghanaian extension services (Britwum and Akorsu 2016).

The situation in **Mali** resembles that of Ghana in terms of the gendered allocation of crops, although recent case studies reveal that Malian women have begun penetrating male domains (Siart 2008). Male household heads make most decisions on land use and resource allocation. The periodic migration of men, however, especially during dry seasons, gives women an opportunity responsibility for traditional male activities (Sida 2004:52).

Female farmers in Mali face the highest level of disempowerment in relation to land ownership in sub-Saharan Africa (e.g. Doss *et al*., 2013). Their access and rights over land use are usually bound to their husbands or other male relatives (Monimart and Tan 2011). Like in Ghana, Malian extension services have tended to exclude individual female farmers and focus on providing agricultural support to women groups (Sida 2004). Africa RISING phase II will direct efforts to increasing female participation and undertaking research into their specific training needs.

A gender value chain baseline survey in Africa RISING communities in **Tanzania** (Fischer, Gramzow and Laizer 2016) shows that there is no pronounced gender division of labour for particular crops, rather a gendered division of income. Men tend to receive income from staple crops (such as maize) or cash crops (such as pigeon pea), while women are more likely to receive income from vegetable sales.

As in Mali and Ghana, communal customary law still determines the allocation of land in rural Tanzania, with men being considered 'traditional landowners', while women gain access to land by virtue of their relationships to husbands, clan or community. In all 295 male-headed households of the sample, only one women was the documented owner of a piece of land. Women in male-headed households appeared to face more difficulties in accessing land than their counterparts in female-headed households.

Differences between male and female respondents emerged in relation to market performance (with a focus on vegetables) and willingness to accept trader prices. Male-heads were more reluctant to accept trader offers than female respondents living in male-headed households. Women in female-headed households were most willing to accept trader prices without negotiation. Africa RISING phase II will include marketing skills in training for female farmers.

Further differences between women in male- and female-headed households emerged in terms of access to credit and extension services. Males have the lowest levels of access to credit. Only 3.8% of men confirmed to having received credit, as compared to 5.1% of female respondents in male-headed households and 10.9% in female-headed households. In response to questions regarding having met extension officers in the last four months, male and female household heads most met with extension officers, to the disadvantage of women in male-headed household.

The situation in **Malawi** in many ways is similar to that in the other three IITA-led project countries. Women are the main subsistence producers in Malawian smallholder households and contribute much of the labour force for food and cash crop production (70%): work on their husbands' fields, as well as on self-managed land parcels, mainly for the cultivation of crops for home consumption (AFDB 2005). Men, in turn, tend to focus on cash crops and generally have most say on issues related to production, consumption and expenditure, as well as resource allocations within the household (Mathiassen *et al*., 2007).

A largest proportion of women in Malawi, than in Mali, Ghana or Tanzania, possess official land titles (32%) due to the large number of matrilineal communities. However, the hidden male dominance in matrilineal systems largely excludes women from participation in land-use decisions (AFDB 2005), except for women in female-headed households. Nonetheless, women's access to land is notably better relative than in the other project countries, and some gender assessors deny the existence of a gender gap in relation to land access (e.g. Mathiassen *et al*., 2007).

Moreover, extension systems do not take into account low literacy levels among women, time constraints facing women and other socio-cultural challenges in interacting with the mostly male extension officers. This leads to low levels of participation by women in extension meetings, training and field demonstrations, with consequences for women in terms of technical knowledge, access to information, and the adoption of available technologies (AFDB 2005).

Africa RISING in West Africa and East and Southern Africa seeks to lessen these challenges by: encouraging both husbands and wives to participate in training sessions, ensuring the training content and materials are appropriate to the language needs and education levels of participants, scheduling meetings at times and venues suitable to women, and employing women as trainers.

However, further gender analyses needs to be undertaken prior to, during and after agricultural interventions, as well as during scaling up, to ensure technologies are tailored to specific gender groups and farm typologies. Opportunities for transforming gender relations need to be identified. In phase II, the focus will be broadened to capture a variety of social differences that might impact negatively on the success of the program. There will be continuous assessment, especially within communities prone to conflict (gender, ethnicity, religion etc.).

Gender interventions

Integrated systems improvement: The long-term adoption of innovations depends among other factors on their gender-responsiveness. In the field of mechanization, animal health, multi-purpose trees, and fodder, Africa RISING scientists have assessed how the technologies interact with gender relations at household level. To assist this kind of assessment, the gender team will develop or modify existing tools. In phase II, the gender team will work more closely with the biophysicists to integrate gender in all research protocols and to support the evaluation of available data. The information generated from this analysis will inform the design and adaptation or modification of interventions that enhance the ability of women and young people to participate in decision-making, strengthen women's access to and control over productive resources, and save their labour and energy expenditure.

Monitoring and evaluation: These activities support internal learning processes and ensure that progress is made against set gender indicators. In phase I, qualitative follow-up studies in Tanzania, as well as most significant change stories in Ethiopia, revealed farmer-gendered perceptions of change in the context of interventions. However, gender-responsive M&E needs to be strengthened through a clear framework with quantitative and qualitative indicators included in the work plans. More emphasis will be placed on the collection of gender/sex-disaggregated data, as well as their analysis and reporting. To ensure a fair representation of women and young people, quotas for participation will be defined. Women's empowerment level and gender parity will be systematically monitored.

Scaling: The question of how men and women can be reached by extension messages has been explored for several Africa RISING sites. The results of these studies will be used to employ appropriate communication channels for women and other marginalized groups, such as videos, mobile phone voice and text messages, women's groups, radio, and information centres. However, obstacles to adoption are not limited to information sharing, but include norms that constrain women's access to resources and benefits. Therefore, different gender transformative approaches will be applied and investigated. Partners with the mandate to deliver on gender will be identified and engaged with at different levels. Partners' capacity in integrated systems approach will be enhanced to maximize impact.

Gender capacity: The gender capacity of Africa RISING and its partners is a key success factor for mainstreaming gender throughout the project. In 2014/2015 the gender teams conducted an individual and organizational capacity assessment with the aim of developing a gender capacity development plan, establishing a baseline against which training efforts can be measured, and providing the management with data to make strategic decisions[9]. In phase II, there will be strategic gender training, as well as gender training integrated with other disciplines. The target group for gender capacity development includes researchers and other partners, such as extension workers, development agencies and farmers. Africa RISING envisages more holistic training packages for farmers that combine technical issues with gender awareness, entrepreneurship and nutrition.

Africa RISING gender analysis training will emphasize Kabeer's social relations framework (1994) and prepare the ground for transformative approaches. For West as well as East and Southern Africa the development of a gender training manual was commissioned in July 2016. Pilot training in Mali, Ghana, Tanzania and Malawi is planned for early 2017.

Africa RISING shall build upon these developments in implementing phase II activities, noting that gender is inclusive of wider social concerns, including the youth as the next generation of agricultural entrepreneurs. Accordingly, rather than treat it as a separate section within this proposal, we have embedded gender in the R-in-D activities above for purposes of inclusivity. In this way, this project will address constraints to gender participation in agricultural innovation by taking into account the different roles, needs, and perceptions of women, the youth, and men in the planning and implementation of intervention packages for improving agriculture production.

[9] Detailed action plans have been developed for Ethiopia, and West, Southern and East Africa. In addition, a gender capacity assessment report for Africa RISING West, East and Southern Africa projects has recently been completed.

Nutrition

Nutrition gaps identified in Africa RISING sites from various baseline studies include:

- Limited crop and livestock diversification farm systems;
- Limited availability and access to nutritious foods, particularly animal source foods;
- Lack of technical capacity in nutrition within government extension systems;
- Inadequate nutrition knowledge and awareness;
- Inadequate consumption and care feeding practices;
- Limited opportunities in nutrition-sensitive value chains;
- Limited post-harvest technologies and, as a result, increased post-harvest losses, soil management/fertility issues; and
- Aflatoxin contamination and food safety concerns.

Africa RISING phase II will contribute to the FTF higher level goal to improve the food security and diet diversity of households. Specific objectives for principal target groups (pregnant and lactating women, women of child bearing age, and children under five) include:

- Increase production of diversified crops/livestock to improve access and availability;
- Increase consumption of diversified diets amongst women and children;
- Improve nutrition knowledge and care practices through effective behaviour change strategies;
- Build capacities for research on nutrition, nutrition-agriculture linkages, post-harvest, nutrition-sensitive soil management and value addition;
- Expand nutrition-sensitive value chains and market linkages for improved nutrition;
- Improve post-harvest technologies for improved nutrition; and
- Identify agriculture impact pathways to nutrition.

To meet these objectives, the following activities[10] will target nutritional outcomes:

- *A nutrition framework and action plan* to harmonize nutrition goals, objectives, activities and indicators across sites.
- *Nutritional assessments* that synthesize nutrition data and draft publications and briefs.
- *Integrated crop and livestock diversification for nutrition*, including to:
    - Promote consumption of nutritious fruits, vegetables and legumes through crop diversification;
    - Promote consumption of animal-source foods through livestock diversification; and
    - Promote diversity for nutrition.
- *Research on soil management* to evaluate the effects of various fertilizer blends on nutritional quality of grain crops and their residues for livestock.
- *Nutrition education and training* to promote behavioural change, policy advocacy and women's empowerment through:
    - The scaling-out of nutrition education and training targeting to delivery institutions;
    - The exploration of partnerships to scale-out nutrition training at community level;

10 Some of these were conducted at some sites in phase I. Phase II will focus on synthesis, scaling and cross-learning.

    - The promotion of innovative behaviour change strategies to improve consumption and care feeding practices amongst target farmers;
    - Behaviour change strategies targeting high-income farmers; and
    - The implementation of gender-transformative approaches for improved nutrition outcomes.
- *Pilot interventions in nutrition-sensitive value chains* with a focus on processing and packaging of fruits, vegetables and dairy products.
- *Carry out post-harvest and product development* research focused on nutrient-dense complementary foods.

Capacity development

Capacity development is a crucial and strategic enabler in the complex process of achieving development outcomes through research. Successful capacity development interventions enhance the ability of both core program staff and partners to contribute to the achievement of Africa RISING objectives, such as partnerships, scaling results, etc. Phase II will have a strong capacity development focus, achieved through a carefully planned intervention strategy with a particular emphasis on:

Capacity needs assessment and intervention strategy design: Africa RISING will develop strategies and interventions for capacity development based on and aligned with FTF objectives and the program theory of change and impact pathways, emerging opportunities, and partner needs and solutions. Capacity needs assessment tools and approaches, customized for Africa RISING, will be designed or adapted from existing models (or both). Needs assessments will determine the gap between required and existing competencies at different levels to deliver expected outputs, achieve outcomes, and contribute towards broader development goals (including the SDGs).

Design and delivery of innovative learning materials and approaches: Africa RISING will invest in a range of tools and delivery approaches in phase II, such as innovative content development and knowledge sharing mechanisms firmly anchored in best practices in learning and instructional design theories (including the use of information and communication technologies). To do this effectively, the program will draw on expert inputs of instructional designers to backstop and work alongside subject-matter experts in the design and delivery of tools and the selection of delivery channels.

Develop Africa RISING's partnering capacities: Identifying and brokering appropriate partnerships models will be a key element of the program's success, notably (but not exclusively) insofar as scaling is concerned. Across the research and development sectors, there is a widespread assumption that everyone can successfully create and sustain effective partnerships; however, in practice, individuals and organizations differ in their capacity to collaborate. Africa RISING faces the challenge of moving from research partnerships to broader, strategic and effective multi-stakeholder partnerships that bolster development processes, from collective diagnosis of problems to co-creation of knowledge and implementation of solutions for impact at scale. Specific methodologies need to be developed and applied to enhance the capacity of Africa RISING in identifying appropriate partners to support the program theory of change and impact pathways. The capacity of current or potential partners, as well as farmers and other key stakeholders, is of crucial importance and will need to be systematically assessed and supported.

Organizational development: Many NARS lack strong capacities in and around research in development. Similarly, the organizational capacity of rural advisory service providers—including extension, and other boundary partners which adapt research results and share them with the next level users—may be weak and constrain the up-scaling of research-based solutions. Therefore, Africa RISING will engage with NARS and boundary partners in identifying and addressing such organizational weaknesses, thereby enabling the scaling of innovations.

Monitoring and evaluation of capacity development: To achieve these objectives, it will be important to integrate capacity development into the overall monitoring and evaluation systems across the Africa RISING ecosystem. This may have particular implications for capturing lessons learned for replication and upscaling, but will be far broader than that, monitoring and evaluating the 'key capacity enablers' across the program.

Monitoring and evaluation

Africa RISING M&E systems are designed to support effective project management, provide data for timely reporting to project funders, and help all stakeholders learn about the project's successes and failures. It also facilitates learning and reflection that informs adjustments to current actions and future intervention design and implementation.

Monitoring

Monitoring Africa RISING FTF indicators will conform to the overarching M&E standards, best practices and core indicators established for the entire FTF initiative. This will be implemented through a decentralized local M&E system with a centralized repository and control of generated data. Empowering and supporting local researchers to monitor their own interventions is key to the smooth flow of information from the field up to the central system.

In this setting, it is envisaged that the M&E team based at IFPRI will focus more on evaluation, which will become crucial during phase II, and less on monitoring that will be decentralized.

The decentralized M&E team will be staffed with locally-recruited data managers/M&E specialists in each project (West Africa, East and Southern Africa, Ethiopian highlands). They will collect data from research teams, both on FTF indicators and agronomic/biophysical data for the central data repository; communicate on the usefulness of the tool; and share evaluation results from the M&E team. They will be the link between the M&E and the country teams.

Monitoring will be led by scientists, supported by the local data managers, to avoid common problems such as:

- underestimating the effort required to collect information;
- the disconnect between log frames and monitoring requirements; and
- challenges in learning associated with the distance between the research and M&E teams.

Monitoring-related activities at IFPRI will focus on:

- Maintenance of the Project Mapping and Monitoring Tool (PMMT);
- Timely reporting of FTF and custom indicators data;
- In-person project monitoring;
- PMMT (refresher) training workshops;
- Cataloguing of Africa RISING innovations;
- Establishment of the beneficiary tracking system (BTS); and
- Data repository supervision of socio-economic, agronomic/biophysical, and SI indicators.

During phase I, the Africa RISING M&E team developed an open-access, M&E data management and analysis platform to serve the needs of research scientist and other stakeholders, the PMMT. The PMMT is ultimately intended to help users understand where and how Africa RISING activities are taking place, and improve project strategies and partnerships for greater impact. It is designed to: inform strategic and project management decisions; help communicate program results to key stakeholders; and understand how programmatic efforts relate to other projects, as well as to useful agricultural information.

For phase II, PMMT training and support materials will be improved, with special emphasis on the different M&E tools, and the data repository will be upgraded.

In phase I, the team focused mostly on monitoring, laying the groundwork for a future mid-line and *ex-post* evaluation. In phase II, special attention will be given to communicating the learning points from phase I to the research teams, something which, supported and guided by the M&E team, will facilitate data management (sharing, uploading, etc.). The data sharing protocols will be transparent for everybody to maximize buy-in and realize the common benefits of the sharing platform, and to establish a two-way support relationship, whereby data requirements will be communicated early on together with their use/usefulness for the program. Communication of M&E deliverables will be undertaken at the beginning and during the course of phase II.

Evaluation

Beyond its formal monitoring obligations, the Africa RISING M&E team will generate data and information on a range of farming-system and livelihood-outcome indicators to enhance research management and meet outcome mapping needs. To inform planning and long-term projections of potential innovation impact at scale, beyond the actual action research sites, and with the delivery of scalable innovations to partners, forward-looking analysis will explore the productivity and sustainability consequences of a range of adoption scenarios and geographic/system spill-over pathways across broader landscapes.

To generate credible evidence about program attribution for scaling up, a quasi-experimental evaluation design—devised by the M&E team in phase I—will be used as a basis for such work in phase II. Unlike project monitoring, which examines and tracks whether targets have been achieved, impact assessment examines how the lives of Africa RISING beneficiaries have changed as a direct (and, if modelled explicitly, indirect) effect of the program. It seeks to provide cause-and-effect evidence and quantify changes in development outcomes that are *directly* or *indirectly attributable* to Africa RISING, and not to other extraneous/ confounding factors.

Information collected as part of the program will support various types of evaluation, especially since a robust evaluation design was put in place at the onset of the program during phase I. To this end, baseline socio-economic data has been collected during phase I among intervention and control communities in five of the six Africa RISING countries (Malawi, Tanzania, Ghana, Mali and Ethiopia) to enable assessment of the program's impact on a range of socio-economic and agricultural indicators, both at household and community levels.

It is envisaged that the same type of information will be collected at follow-up stage during phase II among beneficiaries, non-beneficiary households in target villages, and control households in non-target villages. While the distinction between intervention and non-intervention households within a community made sense in phase I, some or all of the households currently identified as non-intervention may be affected by the program in phase II. Hence, expectations regarding accurate and robust evidence of the effect of the program at the community scale should be reconciled with what can/cannot realistically be delivered within the context of reality on the ground. The M&E team will address these aspects using quantitative, as well as qualitative, analysis.

Building on the team's expertise in using *ex-ante* and *ex-post* evaluation methods, the evaluation-related activities the IFPRI M&E team proposes to undertake in the coming years can be summarized as:

- Farming systems, typology, livelihood, and poverty characterization analysis
- *Ex-ante* and *ex-post* evaluation of Africa RISING innovations
- Follow-up evaluation surveys to conduct relevant applied research using panel data identification strategies
- Targeted case studies and experiments to guide new research streams
- Risk rationing, access to credit, and adoption of agricultural technologies
- Informed scaling up efforts.

Table 3. Monitoring (M) and evaluation (E) activities to be undertaken in phase II

Activity	Remark
Project monitoring, and PMMT maintenance (M)	To be achieved through the PMMT and in-person interactions with Africa RISING researchers
Training to assist with project monitoring (M)	Additional in-country PMMT training
FTF aggregation and submission (M)	PMMT aggregation of single projects into regional level indicators
Beneficiary tracking system (BTS) (M)	Jointly with all the Africa RISING stakeholders
Cataloguing of Africa RISING innovations (M)	In collaboration with Africa RISING local research teams
Socio-economic, agronomic/biophysical, and SI indicators data repository supervision (M)	Data will be collected at various points during project implementation
Data analysis for ***ex-ante* evaluation** (E)	Jointly with Africa RISING teams, other researchers in IFPRI (Biosight, HarvestChoice) and other bio-physical modellers (CIHEAM-IAMM), using DAHBSIM and DSSAT models. Analysis is on-going for Malawi, progressively expanding to the other program countries.
Data analysis for ***ex-post* evaluation** (E)	Also jointly with other CGIAR centres (IITA) using econometric techniques. Various agro-economic outcomes (e.g. yield, income, nutrition) will be examined. Analysis is on-going for Malawi and Tanzania, progressively expanding to the other program countries.
Willingness to pay for **improved** agricultural innovations; risk rationing, access to credit, and adoption of agricultural technologies—**Tanzania** case study (E)	Ongoing

Measuring and monitoring SI

Africa RISING phase I collaborated with the FTF Sustainable Intensification Innovation Laboratory to develop a framework for assessing SI (see Annex 2). Measuring and monitoring SI at a range of scales will provide key evidence for the success of Africa RISING phase II as a whole so the program will embrace and implement the framework as an integral part of its research/development activities.

The SI indicator framework is a decision-making tool to improve probability of success for farm- and farmer-level impact. There are two fundamental questions about sustainability that, by using these indicators, Africa RISING seeks to answer:

- How sustainable is this plot/household/community in comparison with other plots/households/communities?
- If we change something, does the sustainability of the plot/community/household change and, if so, in what way does it change? By monitoring all domains relevant to a project Africa RISING will be better able to detect synergies and trade-offs, and minimize unintended negative consequences.

It is also important to clarify that the framework does not:

- define or quantify 'sustainability', or pre-determine an ultimate state of sustainability or specific practices that lead to sustainability, but rather to guide decision-making, based on evidence-based outcomes, resulting in agricultural systems with improved productivity, environmental, social and economic outcomes.
- cover all dimensions or scales of sustainability, but only those commonly focused on by **agricultural R in D projects**, and it is intended to support the development of standardized methods, but which are flexible enough to be adaptable to different scales of interest.
- replace other frameworks used by individual programs or projects, but rather to provide a simplified, common framework that facilitates cross-program learning and assessment.
- replace adoption studies or identify the best means of up-scaling an intervention. Nevertheless, in some contexts it may offer the potential to inform these efforts, as well as to inform sustainable-intensification-related policy debates.

The framework identifies a set of key indicators for each of five SI domains (productivity, environment, economic, social and human. Ideally, researchers will critically examine the tables for each domain and select the indicators and metrics most suitable for the specific sustainability assessment considering the unique aspects of the intervention and the bio-physical and socio-economic environment. A guide or protocol will detail how to collect the data needed for each metric. This will provide 'gold standard' methods for collecting the necessary data, as well as potential proxy indicators that may be more feasible. The researcher conducting the sustainability assessment will have to decide which metrics are worth measuring robustly and which can be estimated more coarsely. The guide will aim to describe the conditions in which the proxy may be useful and in which it should not be used.

Data management

During testing and scaling-up of SI interventions, various types of experimental data will be collected, such as improved seed varieties, fertilizers, management practices, biomass, soil coverage, water retention, water-use efficiency, and combinations of these. Observational data will be collected on local farming systems and farm households reliant on them. Additionally, it is likely that information on plant specimens and demonstration plots will be collected. During phase I, socio-economic baseline data were collected from farm households. This will be used to better tailor the design of research activities. As interventions take place, research teams will collect additional data on various forms of inputs distributed (such as combination of technologies and packages, training, etc.), and on the beneficiaries. Table 4 shows data types to be collected.

Table 4. Data types

Data type	Description
Observational	Survey data (quantitative, qualitative) or information captured from sensors
Experimental	Information collected in a laboratory or other controlled settings (such as trial, control, or farmer-managed plots)
Simulated	Information projected using computers or other modelling mechanisms
Derived/compiled/ analysed	Secondary information collected and/or contextualized; maps, graphs, and other data visualizations; software or web tools
Physical	Specimens collected or created in the field
Metadata	Descriptions of data—including but not limited to the source, methods and tools used to collect data

In phase I, Africa RISING established an open-access data management platform, in line with the USAID and CGIAR policies. It serves four key purposes:

1. Provide implementation partners with a secure, web-based, data storage and documentation repository that over time constitutes a major Africa RISING knowledge pool supporting further discovery, integration and analysis;
2. Provide a set of procedures to capture, validate and integrate indicators, which can generate periodic monitoring reports on indicators agreed with Africa RISING partners (USAID, CGIAR CRPs and centres, and other national and transnational partners)[11];
3. Provide a live repository for non-indicator variables used to provide baselines, context and input variables to inform systems modelling and evaluations of interventions intended to support farming systems, post-harvest activities, and market-related activities; and
4. Serve as a one-stop structured and searchable inventory of Africa RISING project and partner organizations, activities, and outputs catalogued in a consistent manner across the entire Africa RISING portfolio, thereby enabling investment and institutional data to be linked to a range of data layers. The platform will include both tabular (e.g. plot, household and community), as well as spatial data, and will support management of indicators and other variables as time series (in regular or irregular time series formats).

In addition to raw data at the unit level, researchers in Africa RISING produce data collection tools. These tools may include questionnaires, focus group guidelines, or other templates and technical manuals used to organize and collect the data. All Africa RISING researchers will be required to share data collection tools and supporting documentation to facilitate understanding of the data, and further enhance collaboration among partner institutions. In accordance with the program's data management plan, all these tools and data will be accessible through the ILRI-hosted web-based repository and via the PMMT website. (Guidelines for data management and handling are outlined in Annex 5).

[11] Wherever possible data is gathered dynamically from partner-curated data holdings accessed through metadata query and harvesting tools, and APIs. Data standards will be adopted, developed and supported by the M&E data and knowledge management support team over the life of the Africa RISING initiative.

Communications and knowledge sharing

Providing access to excellent knowledge sharing, communication and information exchange facilities and expertise is a key input to ensure that the program and its associated projects operate effectively and have their intended results.

At the program level, phase I was directed towards five main areas:

1. External communication—Informing and engaging with wide audiences
2. Research for impact—Translating outputs into outcomes, getting knowledge into use
3. Knowledge sharing and learning—Enriching project learning interaction and exchange
4. Publishing—Capturing, organizing and disseminating research products and outputs
5. Internal communication—Linking the project teams

These will continue to underlie activities in this area. As indicated in table 4 however, communications and knowledge sharing activities in the program will be re-oriented to meet the evolving needs of phase II. In particular, the following issues are becoming more and more important:

- A much greater emphasis on cross-project and cross-issue exchange and learning to support scaling and spill-overs, especially through communities of practice mentioned earlier
- A much greater emphasis on packaging to directly support scaling at project and country level
- Supporting wider engagement with 'sister' projects—such as the SI innovation lab—to build more global knowledge bases
- Increasing the dedicated support for communications at program level to deliver more and further.

Several specific delivery areas have been identified for phase II:

Communicating with and for actors on the ground: Investments in communication can strengthen the ability of farmers and communities to make informed choices about how they plant, rear and sell agricultural products or engage in managing their natural resources. In phase II projects, communication will be much closer and intensive on the ground to engage and communicate with various actors (farmers, community members, district officials, private sector operators, NGOs, etc.).

Communicating and knowledge sharing for policy influence: Communicating Africa RISING outputs with policymakers at different levels (e.g. national, sub-national and district level) will ensure that the research is not just *about* development, or *relevant to* development, but will actually influence development. Different strategies will be adopted for the various policymakers in the Africa RISING project countries. Some of the proposed approaches to be applied include:

- Delivery of briefing papers/policy briefs to strategic policy players within the various project countries and engagement with them around key issues;
- Ensuring the participation of certain strategic policymakers for major Africa RISING project and program events (e.g. program learning events, review and planning meetings, etc.); and
- Policy panels and briefing sessions.

Communicating about the program, the science and results: In phase II, more Africa RISING communication work will be devoted to communicating and sharing the science undertaken and the research results generated. Many of the same products and channels as now will be continued. It is assumed that more 'results' from phase I will provide a stronger foundation to engage with media and policymakers as well as development partners keen to scale specific technologies.

Communicating, engaging, learning and sharing: Building on phase I lessons, a collaborative culture will be reinforced in which all partners are encouraged and facilitated to share their work, questions and resources with one another and are subsequently better able to inform others regarding the progress and process of Africa RISING as a program. A key mechanism for this are the proposed communities of practice. This will also include facilitating process learning and sharing through, for instance, annual program learning events, exchange visits, 'grey literature' seminars; setting up collaboration tools to collaborate closely across the regions; documenting process and progress milestones; and developing partners' capacities to communicate and engage with one another through training, mentoring, etc.

Communicating with investors: As in phase I, it is critical to generate targeted information to investors, especially USAID, in Washington DC and in country and regional missions. This includes: success stories, infographics and other graphic formats, and contributing to platforms like Agrilinks.

As in phase I, these activities will be undertaken across the program. Each project will have its own 'local' communication strategy as well as dedicated capacities. These are likely to focus much more on country-specific 'communication for development'—ensuring that communication opportunities are taken up within R in D activities.

In addition, a program-wide component will:

- Lead program-wide lesson and successes documentation work. In the past this included commissioning photo-journalists to document results and stories.
- Support, facilitate and act in a 'secretarial' role to the 'program coordination team' and other program-wide mechanisms intended to provide consistency and coordination across the program.
- Organize and facilitate an annual learning and/or scientific symposium bringing together partners from across the program and associated organizations. This could also act as a review and planning mechanism across the program as a whole.
- Support 'peer exchange/learning' visits for national scientists in the different projects to spend time visiting related projects in other regions.
- Organize at least one cross-regional scientific seminar per year, featuring research from all three regions.
- Organize support and training for communications for program participants.
- Provide an (updated) overall 'external' web face for the program where activities in the three projects, as well as any cross-cutting activities are reported and essential reference information is accessible.
- Ensure that outputs meet branding and open access standards.
- Provide a framework and open platforms and tools to share products and results: images and photos, presentations, posters, social media, video, etc.
- Support and facilitate internal collaboration and communication across the program.

Core principles

Systems approaches

Systems approaches have been applied widely over the last 30 years to the elaboration and alleviation of constraints to increasing agricultural productivity in a sustainable manner. In spite of their demonstrable successes (see Annex 3) there has been a lack of clarity in some circles about the value added by systems research in the wider context of R in D programs. This section seeks to explain the value of systems approaches taken by Africa RISING.

Phase I gave prominence to the role of innovation for SI within the overall household system. It considered factors influencing innovation adoption as often extrinsic to the innovation *per se* but manageable at the household scale. Phase II will build on these approaches by using integrated system research (ISR) to identify, evaluate and adapt technological, farm management, institutional and policy interventions to improve household income and nutrition, reduce poverty and improve healthy ecosystem functioning.

By capturing diversity in farms and farming systems and analysing multi-scale and multi-dimensional interactions, ISR identifies promising SI options for scaling. Further, the assessment of current system limitations helps articulate the conditions necessary to enable the equitable distribution of growth, avoiding externalities.

ISR provides tools and approaches to identify, design, test and adapt solutions to problems plaguing rural livelihoods that: (i) have positive impacts on the different realms constituting livelihoods (e.g. food and nutrition security, income, natural resource integrity); (ii) respect equity between households, communities, and different stakeholder groups; and (iii) are sustainable in economic, social, and environmental terms.

ISR recognizes that improving the productivity or income of a single production unit can have a negative impact on other production units. The avoidance of such unintended consequences is another key ISR goal. Well-executed ISR can deliver significant advantages in terms of innovation adoptability as it implicitly recognizes that it is not only governed by factors intrinsic to that innovation. Innovation evaluated within a systems context will have been more robustly evaluated for adoptability. Moreover, effective prioritization, targeting and scaling is not possible without a view of the relative importance of the threats and opportunities facing farmers managing different system components together. An arbitrary focus on a specific system component is likely to reduce the ultimate relevance of the research.

In alignment with these goals, ISR embraces approaches that:

- Aim at location-based system intensification and diversification beyond increases in single crop productivity.
- Pursue system intensification by minimizing trade-offs and exploiting synergies and complementarities between system components, particularly tree-crop-livestock-soil-water interactions.
- Address contrasting stakeholder perspectives related to the prioritization of the system dimensions of productivity, natural resource integrity, as well as policies, markets, and institutions.
- Differentiate and explicitly address diversity of farming systems, e.g. in endowment and efficiency, thus allowing nuanced approaches to scaling up of best-fit technologies.

- Strengthen the science–policy interface that will enhance government and international bodies' delivery of changes on the ground to rural people, by basing research prioritization on sound diagnostics in which all potential stakeholders are given the opportunity to participate.

ISR fosters connectivity with markets and value chains and collaboration among farming households, communities and development partners, through partnership platforms for collective prioritization, decision-making and implementation. The activities and components in agricultural systems interact, and ISR can help to quantify and foresee how proposed changes affect overall system performance for different productive, socio-economic and environmental indicators, putting newly developed innovations and technologies in a larger perspective. By doing this, the focus operates at multiple scales and across multiple domains, for example by evaluating the effect of a new crop variety on biophysical aspects of the farm and landscape (e.g. productivity, pollution mitigation), but also on socio-economic aspects of the household and community (e.g. income, gender equity).

ISR addresses the heterogeneities in landscapes and populations encountered when deploying innovations to larger target groups and scaling out. It acknowledges that innovation and adaptation are dependent on local biophysical conditions, household endowments and the socio-institutional environment. Therefore, various methods, such as spatial analysis and household typologies, are available to analyse and thus exploit these heterogeneities, supporting the scaling out of technologies. These are absolutely essential for effective targeting, and ensuring and characterizing the scaling potential of the generated innovations. Moreover, ISR can analyse systems dynamics over time, thus allowing assessment of interventions risks and thereby guiding a stepwise approach towards, for instance, the SI of agricultural production.

Since ISR focuses on multiple performance dimensions (or goals) of systems at the same time, it can quantify trade-offs and synergies among indicators in a straightforward and intuitive way. Because it provides insight into implications of adoption and behavioural changes at larger scales beyond plot level, it is highly suitable for evaluation of development outcomes and can support identification of appropriate policy instruments, e.g. to choose between different incentive schemes and extension efforts.

The tools used in ISR thus allow the construction of 'what if' scenarios and exploration of windows of opportunity for future development and system dynamics. This allows a quantitative assessment of adaptability and resilience to, for instance, climate change, policy regimes and market volatility.

The ISR perspective on innovation and impact, broader than the monitoring of technology adoption *per se*, comprises three strongly related dimensions:

- The potential for change, i.e. the availability of options to adapt and improve management systems, such as new practices and technologies, focusing on the possibilities for implementation and adaptation of a basket of technologies and reconfigurations of existing practices, rather than use of single technologies.
- The preparedness to implement changes from the basket of technologies, which is determined by human factors such as the competence (ability and flexibility) of land managers and by the support and incentives they receive from their socio-institutional environment.

- The performance of alternative system configurations, which involves an evaluation of the effects of the changes on productive, environmental and socio-economic performance indicators.

To reach impact, ISR can assist in the identification of leverage points by assessing the potential for change and by improving the competence (knowledge, skills, etc.) and connectedness (social networks, community and institutional support, etc.) of system managers.

Typologies and targeting

Projects, such as Africa RISING, that aim to support sustainable innovation in farming systems have to deal with heterogeneous populations of farmers within rural landscapes. Creating a typology is one of the approaches to deal with this diversity. As part of defining the contexts for Africa RISING vision of success (see section 3), typologies are very important in giving a clear picture of target beneficiaries.

A typology groups the farms into relatively similar clusters. This can help to:

- Identify suitable farms to target innovations; this assumes that not all innovations are appropriate for all farms, and that structuring into groups supports the identification of suitable farming systems.
- Allow tailoring of technologies to best-fit particular farm types (niches).
- Scale up effects of innovations; on the basis of characteristics of the clusters in a typology, we can 'populate' a landscape and interpolate what the impacts if larger numbers of farmers adopt the innovations.
- Select farms to work with in projects; in co-innovation projects, it is important to work with farms representative of the diversity in a landscape. For that, representative farms from different clusters can be selected.
- Scale out innovations; taking into account the heterogeneity in a population, extension messages, policies and other incentive schemes can be formulated to further spread the use of designed innovations.
- Explain trends and farmer 'behaviour' (functional characteristics, including SI indicators), and the verification of the impact of interventions for different farm types (*ex-post*).

A number of approaches, some more suitable to certain situations, to the construction of typologies are available:

- Statistical, using quantitative data often derived from farm or household surveys, employing multivariate statistical methods.
- Expert-based, grouping informed by the knowledge of expert about the farming community.
- Participatory, grouping of households on the basis of community perception.
- *Ex-ante* versus *ex-post*.

Quantitative approaches have the advantage that they are reproducible, while more qualitative approaches can potentially incorporate less tangible insights, such as cultural patterns. The quality of results of both approaches can be compromised, for instance by inaccurate data collection (quantitative) or by power relations or other socio-institutional pressures (qualitative). Both approaches are subjective.

Approaches for construction and use; all approaches require good knowledge of: the biophysical conditions, the community, its cultural practices and the institutional environment. Based on these insights, an initial hypothesis regarding community diversity can be formulated, tested–using one of the available quantitative or qualitative approaches–either confirmed or rejected, and then adjusted.

In Africa RISING phase II, there is a recognition that introducing different innovations require the use of different typologies. For instance, targeting livestock-related interventions could require different farm clusters than targeting legume- or crop residue-related interventions.

Demand-driven 'research-in-development'

Traditionally, R4D programs develop and validate solutions that address important problems in relation to smallholder agriculture. Products are transferred to national research and extension systems for integration in their smallholder programs and scaling initiatives. Despite the use of farmer-participatory approaches, three major issues hamper the scaling process:

(i) These products may not be the most demanded by farming households or scaling partners or may be outside the scope of the scaling initiative;
(ii) The performance of such 'best-bet' solutions may not be consistent within the operational domain of the scaling initiative, with many farmers potentially not generating the anticipated benefits from these solutions; and
(iii) Some level of local adaptation, very often needed in view of the varying contexts within which smallholder agriculture takes place, is absent.

Alternative models place R4D within the context of operational development initiatives, often led by (non-)governmental development partners. In such models, the R4D program is fully aligned in terms of space and time with an active scaling initiative assisting a relatively large number of farming households or farmer associations within a defined geography. Such an approach is often referred to as 'research-in-development' and has a number of operational consequences:

(i) Research issues are prioritized in accordance with the specific needs of the scaling projects and its beneficiaries, including prioritization in case of multiple demands;
(ii) The target area of the R4D program is the same as that of the development initiative, whereby variation in context variables that could affect the performance of products and solutions is expected to be integrated into such program; and
(iii) The output and outcome targets of the R4D program are well-aligned to those of the development initiative; and
(iv) Any research, demonstration, or adaptation activities take place within the target area of the development initiative, with the direct engagement of the farming households and associations targeted, and the development partners facilitating these actors (Paul *et al.,* 2014).

Following such an 'R-in-D' logic has a number of important advantages:

(i) Variation in performance of improved interventions within the target environments is embedded in the research process (Vanlauwe *et al*., 2016);
(ii) Through participatory evaluation, 'best bet' options are transformed into 'best fit' options, addressing farmer production objectives and resource constraints, (Giller *et al*.. 2011);
(iii) Improved options are evaluated as these interact with livelihood systems, operating beyond individual plots or farms, (Coe *et al*., 2014); and
(iv) M&E processes can generate new research questions based on the identification of secondary problems affecting system productivity (Giller *et al*., 2013). Obviously, placing research in development also creates a real demand for the products and solutions to be developed.

In phase II, Africa RISING will seek to broaden its approaches from R4D to 'R-in-D', with the development initiatives being USAID-mission investments, government programs, or other scaling investment requiring agricultural R4D. While the program will continue to deliver on its own specific output and outcome targets, impact-at-scale towards hundreds of thousands of households will be delivered through effective cooperation with such scaling initiatives.

Program coordination

The Africa RISING program has no management entity for centralized decision-making. However, its Program Coordination Team (PCT) ensures a common understanding of SI and its potential contribution to FTF goals across the three projects. The PCT also helps to identify opportunities for experience sharing and cross-project support, both informally and through an annual program learning event. Further, program-level scientific advice is provided by the Science Advisory Group (SAG) comprising external experts with experience relevant to various aspects of SI.

For phase II, Africa RISING proposes to appoint a program assistant (PA) reporting to the PCT under the supervision of the project manager in the appointing institute. The PA will:

- Facilitate liaison amongst the three regional projects, the M&E team and the donor;
- Organize *ad hoc* program-level meetings and events; and
- Facilitate SAG activities, (including organizing meetings).

Coordination responsibilities at the program- and project-levels lie with the following bodies:

Program Coordination Team (PCT)

The PCT provides technical and managerial advice and coordination across the three projects. By integrating the three regional projects into one coherent program, each region benefits from the experiences and successes in other regions.

Terms of reference of the PCT:

- Provides an interface with the donor for the program and regional projects;
- Tracks project reports, and provides feedback and advice to the individual project management teams;
- Provides support for coordination and integration, but not supervision, across projects;
- Convenes/ sponsors/ approves the research approach design process, including consultation with the qualified external experts of the SAG;
- Sets standards and guidelines, approves objectives/ outcomes, etc.;
- Facilitates good communications and learning;
- Advises on communications and M&E teams' work plans;
- Determines the focus of an annual program-wide learning meeting;
- Promotes coordination, alignment, and integration with related research projects;
- Meets annually face-to-face and virtually as required; and
- The Communications Team plays a secretarial role and reports on PCT meetings on the program website.

Composition of the PCT

- Chair: Rotates annually between IITA and ILRI
- IITA Project Manager
- ILRI Project Coordinator
- Monitoring and Evaluation team lead
- Communications team lead
- USAID Activity Manager

Monitoring and Evaluation Team (MET)

The Monitoring and Evaluation Team coordinates across the three projects and has a separate budget for data management, M&E activities, and M&E reporting to the donor.

Terms of reference of the MET:

- Ensures the conduct of baseline and follow-up surveys;
- Conducts modelling for forward-looking impact projections, impact assessment, and intensification-pathway analysis;
- Provides ongoing data management and analysis;
- Provides and maintains an open-access data management and analysis platform;
- Provides monitoring reports and projections;
- Coordinates multi-scale M&E activities (program, project, country, and sub-system levels) and reporting to donor, including compliance with FTF M&E requirements;
- Supports data management and reporting for semi-annual project reports;
- Provides analysis and research on the effects of the program at various scales;
- Supports PCT, project coordinators, research teams, and the donor in data analysis; and
- Keeps the PCT, Communications Team, and project steering committees informed of activities.

Composition of the MET

- Led by IFPRI, through staff based in Washington DC;
- Three regional M&E officers (Ethiopian highlands, East and Southern Africa; and
- Two country M&E officers in West Africa (Ghana and Mali).

Communications Team (CT)

The Communications Team facilitates, on demand, program meetings and communications, leads on public awareness, and hosts, populates and maintains the program website, collaborative workspaces, and related communication platforms.

Terms of reference of the CT

- Leads public relations and outward facing communications;
- Provides a coordinated and consistent communications approach/ strategy across the three projects and publicly on behalf of the program;
- Manages program website and collaborative spaces with document repository and associated platforms;
- Produces program communication products for different audiences;
- Builds and maintains productive relationships with USAID FTF and other related communication initiatives;
- Ensures, as far as possible, that outputs from the program are documented, published and made widely accessible;
- Ensures compatibility with USAID and CGIAR communications guidance and establishes consistent branding for the program and projects;
- Supports the PCT and the annual program learning event (and other cross-project learning as demanded);
- On demand, provides facilitation services for all program and major project meetings;
- Draws in communications expertise from partners;
- Promotes the effective use of knowledge, communication, and ICTs within the projects;

- Provides email/ hard copy communication when required for program and project partners without adequate web access; and
- Facilitates peer-to-peer learning.

The communications effort is led by an Africa RISING communications officer with support from centre communications teams.

Project steering committees (PSCs)

At regional project level, project steering committees provide advice and oversight of research, budget, work plan, M&E and communications, ensuring that each project conforms to program objectives and core principles defined in the research document. CGIAR representatives will be appointed by the chairs, advised by the Project Coordinator/ Manager.

Terms of reference of the PSCs

- Provides advice on and oversight of project activities;
- Provides science guidance to project implementers to ensure conformity with core program principles and objectives;
- Guides project planning and activities;
- Approves project work plans and budget;
- Liaises with MET to oversee project-level M&E, keeping PCT informed on all reporting;
- Keeps PCT informed of activities via the Project Coordinator/ Manager;
- Reviews and makes suggestions to Project Coordinator/ Manager on semi-annual technical progress reports to USAID; and
- Decisions of the PSCs are made by consensus during an annual meeting in person and occasionally as called by the chair.

Composition of PSCs

- West Africa
    - Chair: IITA
    - Project Manager, serves as secretary
    - Project Chief Scientist
    - Project M&E lead
    - Project communications lead
    - Research partners: CGIAR, CORAF, NARS, AGRA

- Ethiopian highlands
    - Chair: ILRI
    - Project Coordinator and Chief Scientist
    - Project M&E lead
    - Project communications lead, serves as secretary
    - Research partners: CGIAR, NARS, and others as designated;
    - Development partners such as Agricultural Transformation Agency, representatives from regional and federal extension offices

- East and Southern Africa
    - Chair: IITA
    - Project Manager, serves as secretary
    - Project Chief Scientist

- Research partners: CGIAR, sub-regional research organizations (ASARECA/SADC/ CCARDESA), NARS, and others as designated
- Project M&E lead
- Project communications lead

Science Advisory Group (SAG)

The SAG advises the PCT. It has a major role concerning priority setting, establishing strategic partnerships and external linkages to ensure that the technical program is well aligned, and that the needed set of partners participates to achieve the program goals and objectives.

Terms of reference of the SAG

- Provides advice on scientific direction, science quality and feasibility of proposed approaches for the successful implementation of Africa RISING;
- Provides advice on strategic partnerships needed to implement Africa RISING;
- Makes recommendations on opportunities to improve program performance;
- Provides advice on strategic elements, such as gender mainstreaming, innovation, capacity development, essential for the success of Africa RISING;
- Reviews the global program performance and the relevance of its outcomes;
- Conducts internal reviews of the three regional projects in preparation of donor-commissioned external program reviews;
- Advocates and lobbies for Africa RISING with other donor agencies to attract further funding; and
- Provides advice on future developments in the science of the program.

Composition of the SAG

The SAG comprises individuals that bring R in D expertise and insights from diverse public and private sector institutions. The membership should include individuals who have expertise in the following areas:

- Farming systems research
- Gender research
- Participatory research approaches
- Multi-stakeholder research
- Setting up and managing multi-stakeholder platforms
- Economic, impact assessment, policy-oriented research
- Communication

The team comprises a maximum of six individuals, experts with overlapping experiences. The project chief scientists and project coordinators/ managers are *ex-officio* members of the group. Members are volunteers and receive an appropriate honorarium agreed by the PCT and are reimbursed actual costs of travel.

The Africa RISING PCT selects the SAG members. The SAG nominates its chair and secretary, to be ratified by the PCT. Committee membership will be for two–three years to allow staggered turnover of members. The group will meet twice a year; one meeting could be virtual. Members should dedicate eight days per year for their work with the group. In the case of the Chair, this commitment should be 10 days. The Chair will report annually to the PCT and liaise with the PCT members as the need arises.

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Annex 1: Phase I results and lessons

Key elements of the phase 1 approach

1. Africa RISING intervenes at **household level** but acknowledges that households interact with and influence various dimensions beyond the household scale at community, landscape and regional levels. Research activities at this scale focus on understanding household needs and incentives to support effective evaluation, adoption and adaptation of the most relevant interventions.
2. **Farm typologies** and **entry points towards sustainable intensification** (SI) are identified, based on the overall characteristics of a specific development domain and farming systems, as well as the resources available to a specific household. Targeting specific households with a specific set of resources and livelihood objectives is a crucial strategy.
3. **SI** requires the adoption of various innovation components, each with its own challenges, towards large-scale uptake. Africa RISING will evaluate the 'robustness' and 'riskiness' of specific interventions and then develop pathways to integrate more components as households move up the intensification ladder.
4. **Development domains such as** high population densities, good access to markets and appropriate agro-ecological conditions **are the main drivers of intensification.** At site level, Africa RISING aims to understand the current status of each of those drivers and construct similar development domain types—to guide scaling up processes and approaches.
5. **Research-for-development (R4D) and innovation platforms** facilitate meaningful and effective interactions that prioritize, guide and evaluate the various research and development processes. The platforms help connect farmers to profitable and efficient value chains. They also assist in the design, implementation and evaluation of project activities and the dissemination and communication of research findings.
6. **Demand-driven entry points** towards SI—technologies or technology components, including social and institutional arrangements—are a consequence of diagnostic and situation analysis, *ex-ante* potential of certain interventions and technologies, and agreement among partners in the R4D platforms.
7. Research is directed towards four **overall outputs**, with complementary investments in M&E and learning, as well as communications and knowledge sharing:

    - **Research output 1:** Situation analysis and program-wide synthesis. Activities under this output seek to (i) ensure best-bet or best-fit interventions are aligned to priority constraints—within development domains—to improved livelihoods and to the prevailing livelihood and production environment conditions and (ii) develop program-wide synthesis and lessons learned across the various target areas.
    - **Research output 2:** Integrated systems improvement. Activities under this output will test, validate and adapt specific interventions seeking to improve farm-system productivity, income and natural resource status.
    - **Research output 3:** Scaling and delivery of integrated innovation. While the first two outputs will generate integrated technology combinations effectively targeted to meet farmers' real development needs, the scaling and delivery output will develop appropriate approaches for scaling out of innovations, taking into account the often complex nature of system interventions.
    - **Research output 4:** Integrated M&E process. A participatory M&E framework will ensure: the outcomes related to the various outputs are clearly understood; the lessons learned from one output are fed back into other outputs; and the linkages between the various outputs are operationalized.

Africa RISING **M&E activities** also included work on: (i) a structured stratification schema (by geography and household categories) and an action research and control site selection process; (ii) a program-wide, spatially-enabled M&E data management and sharing platform; and (iii) initial steps in embedding a farming-system modelling capacity into the program's M&E toolkit.

To support the delivery of program activities and outcomes, the program implemented various **communication, knowledge and information** activities contributing to: Communicating for wider influence and impact—engaging with and influencing wide audiences; translating the program's outputs into research, development and policy outcomes, getting knowledge into use; knowledge sharing and learning—enriching learning, interaction and exchange across the program; publishing—capturing and disseminating research products and outputs of the program; and internal communication—linking and connecting project and program teams.

Baseline and situational analyses

In East and Southern Africa, tools and protocols were compiled and used for baseline surveys and typology identification at the three country levels and results have been compiled for Malawi. Different farm types have been identified through systematic quantitative and/or statistical analysis of the baseline data in Malawi and will be validated in phase II for (i) suitability to target and scale innovations, and also used for *ex-post* assessment in explaining trends and farmer 'behaviour' (functional characteristics, including SI indicators[12]). Some of the outputs are identified below:

- Farming systems characterization. The objective of the first phase of farming systems analysis within the Africa RISING East and Southern Africa project was to identify constraints to and entry points for SI and innovation at farm level;
- The survey of post-harvest losses in Babati district provided relevant information regarding the causes and extent of food waste in the project area, and the information served as a basis for the introduction and testing of improved storage technologies.
- An agronomic survey concluded that the cropping systems used in Babati district should be preferentially supplemented with mineral fertilizers while optimizing plant density, increasing manure application and appropriate varietal choice in order to reduce the yield gaps.
- An assessment of maize yield gap and major determinant factors between smallholder farmers in the Dedza district of Malawi demonstrated that closing the yield gap in maize mixed farming systems requires integrated an approach to addressing agronomic, biophysical and socio-economic constraints.
- A gender-awareness study of drivers of farmer experimentation in central Malawi found almost 600 examples, with over two-thirds carried out by women farmers and the vast majority involving new crop varieties. Integrated nutrient management was another area of farmer experimentation.
- Some baseline studies that have been concluded but not published can be found in the East and Southern Africa project annual reports and include: (i) Gender studies (disaggregated baseline data to inform technology design, testing and deployment, and implications for technology uptake); (ii) Market analysis for vegetables; (iii) Feed Assessment (FEAST); (iv) The mapping of the incidence and severity of maize lethal necrosis in northern Tanzania; and (v) The identification of key diseases and pests of maize and legumes in Tanzania.

[12] For a full discussion on SI framework indicators, see Annex 2

In the East and Southern Africa project, regions, districts and communities were selected using bio-physical and socio-economic criteria for long-term research trial establishment. In Ghana, the communities were mobilized and analysed to identify constraints to and opportunities for SI.

IFPRI conducted a general baseline survey in Ghana and Mali. Different farm types were identified using the baseline data. They will be validated in phase II for suitability to target and scale innovations, and also used for *ex-post* assessment. The research teams conducted situational analyses surveys and reviews to enable them identify better targeted research entry points. Some of the outputs are identified below:

- *Farming systems were analysed*. Farming systems of the intervention communities in Ghana and Mali were characterized to identify constraints to and entry points for SI and innovation at farm level. The statistical (top-down, researcher-defined) and participatory (community-based, farmer defined) approaches to the construction of farm types were compared using household data from northern Ghana. The results showed the incorporation of farmer perspectives might provide further context and insight into the drivers of diversity.
- *Integrated crop-livestock systems were reviewed.* A workshop was organized to review potential and opportunities for intensification of ruminant and non-ruminant production systems in northern Ghana in 2012. A workshop proceeding was published.
- *Household nutrition and food safety issues were documented:* In Ghana, a 522-household nutrition survey results showed that the consumption of livestock products was low relative to crops. Dietary diversity scores varied across regions. A survey of nutritional status of about 1300 children revealed that about 1% are severely malnourished, 6% moderately malnourished, 19% were at risk of being malnourished, and 74% were normal. In Mali, food consumption patterns were characterized, and a study to assess dietary and relative share of vegetables in diets was completed and nutrition guidelines were developed.
- *Ruminant feed resources and feed markets were characterized.* An assessment of existing and potential feed resources, their uses and seasonal gaps using FEAST identified natural pasture and crop residues as the key feed resources for ruminants in northern Ghana. In Mali, grazing natural pastures and crop residues accounted for 40–55% and 20–25% of diets of ruminant respectively. An assessment of feed markets in Ghana found that trade in crop residues such as cowpea hay, groundnut haulms, agro-industrial by-products (bran of maize, rice and sorghum) and fresh grass was fast-growing in the region, especially during the late dry season (February to April).
- *Rural poultry and pig production systems were characterized.* A rural pig survey involving 114 households in northern Ghana showed that farmers obtained starter stock from neighbours. Poor housing, health care and feeding management were the major production constraints. An assessment of the rural poultry enterprise showed that domestic chickens and guinea fowls kept under semi-intensive management were the predominant species. Live birds are sold to generate cash for food, school fees or health bills. Key constraints to SI of rural poultry production were pests and diseases, high chick mortality, predation, lack of technical knowhow and feed shortages.
- *Cereal-legume-vegetable cropping systems were analysed.* An analysis of the vegetable production systems in Ghana showed that 30% of the households surveyed grew vegetables for cash and home consumption. Most of the vegetables were grown under rain-fed conditions in pure or mixed stands with maize, millet and sorghum. In the Upper East region, cereal–cereal and cereal–legume cropping systems predominate.

Integrated research

In East and Southern Africa, some of the integrated technologies are being tested for uptake and adaptation at the pilot scale including:

- Intercropping two legumes. The pigeonpea/groundnut doubled-up legume system is the most advanced in development to the extent that appropriate approaches have been recommended for farm typologies based on land size. Doubled-up legume trials under conservation agriculture are testing for additional benefits as the plant population of groundnuts can be increased to a more optimal spatial arrangements, increasing the yield of groundnuts by at least 50% without compromising the pigeonpea yield. An innovative doubled-up legume arrangement involving *Gliricidia*, pigeonpea and maize intercropping is being validated for the extra production of fodder and wood.
- Integrated soil fertility management. Maize was intercropped with improved varieties of several legume crops (common beans, pigeonpea, soybean, groundnut, lablab, *Gliricidia* and *Tephrosia*) aimed at fitting these varieties in appropriate ecology and management (space and time) options. In some cases, these were complimented with fertilizer applications at recommended or micro-dose rates (for enhanced efficiency of fertilizers), or rates established following implementation of fertilizer response trials.
- Soil water management. *In-situ* water harvesting and retention tillage technologies were evaluated in the semi-arid study sites and the resulting higher soil moisture storage increased yields by over 25%, and reduced runoff losses two to fourfold.
- Soil erosion control. East and Southern Africa scientists mobilized communities to implement soil erosion control measures at landscape level. Physical structures (fanya juu) and biological windbreaks were applied. Biological windbreaks can also be managed to be sources of fodder. Recommendations were generated for slope management and slope length combinations that would determine structure spacing to reduce soil losses below a threshold value.
- Integrated soil, crop and livestock production. A range of technologies are available to increase farm productivity, but rather than focus specifically on farm components, the broader management practices should focus on investments that could lead to increased system productivity and help protect the natural resources. Improved forage species were introduced and are being evaluated for their: one-stop contribution to soil fertility improvement (N-fixation, erosion control); increased crop productivity through intercropping and complimentary supply of quality feed for increased milk production; and quality manures. Proof of concept requires long-term trials and these are expected to continue in phase II.
- Vegetable production. Originally introduced for purposes of increasing variety in crop production and, therefore, nutrition security, the combined use of healthy seedlings with good agronomic practices increased tomato production by 340% and African eggplant and Amaranth by 280% each. This turned out to be more of an economic venture and generated additional interest in identifying methodologies for better storage of the increased product quantities and accessing viable markets. Livestock nutritionists have started using non-edible components of the vegetable plants as feed components in poultry rations.
- Participatory mother–baby trials. Participatory trials are, by their nature, unintended approaches to scaling because farmers observe and learn from these trials, in addition to the scientists' gain from farmer knowledge. The trials designed to generate basic science are mother trials. When the farmers are facilitated to implement their preferred treatments on their own farms, becoming baby trials, it

offers additional potential for technology adoption as wider communities are exposed to the technologies and educational support, but also a learning opportunity on technology adaptation and challenges to adoption. For the most part, the East and Southern Africa project adopted this approach implementing, for example, 32 mother trials and 1400 baby trials in central Malawi, and 240 mother and 688 baby trials in the Babati district of Tanzania over the project period.

In West Africa, some of the integrated technologies being tested for uptake and adaptation at pilot scale include:

- Improved crop varieties and cropping systems were identified and disseminated: Farmer-preferred, high-yielding, varieties of cereals (maize, rice, and sorghum hybrids), legumes (groundnut, dual-purpose and early-maturing cowpea, early and medium maturing soybean) and vegetables (okra, Roselle, tomato, eggplant and pepper) were identified. The improved varieties were combined with several agronomic practices to develop and disseminate more productive cropping systems.
- Integrated systems tested included:
    - Cowpea variety, planting date and insecticide spraying regime.
    - Soybean variety, inorganic fertilizer and Rhizobium effects on grain yields (appropriate cultivar and integrated soil management practices for intensive soybean).
    - Drought and Striga resistant extra-early, early and medium maturity maize to nitrogen fertilizer.
    - Cereal (maize)–legume (cowpea, groundnut, and soybean) strip-cropping in ratios of two rows of maize: two rows of legume or two rows of maize: four rows of legume.
    - Sorghum hybrid variety and fertilizer micro-dosing.
    - Groundnut variety and phosphorus fertilizer rates for improved crop yields.
    - Cereal (maize)–vegetable (Roselle, tomato, eggplant, okra, peppers) intercrops.
    - Rice variety and nitrogen fertilizer rate to intensify rice production.
    - Hybrid maize and cowpea growth types.
    - Integrated maize–livestock cropping systems with sheep and goat stocking density, maize planting density and nitrogen fertilizer level.

- Approaches to sustainable natural resource management were developed.
- Participatory approaches were used to document and validate local conventions in intervention communities in Mali to reduced conflicts between crop growers and herders.
- In Mali, watersheds were established and characterized, shallow wells in the watersheds were characterized for effective water management.
- The effects of soil and water conservation methods on soil water cycles and crop production were compared.
- Options to improve food storage and mycotoxin management were tested and disseminated.
- *Reducing post-harvest losses in cowpea and maize*: An on-farm trial to reduce post-harvest losses in maize and cowpea showed that grains stored in PICs sacs and plastic drums recorded little or no losses compared with the farmers' practice of using the jute sac. Using Phostoxin and Actellic Supper as protectants resulted in better control of losses than not using protectants.
- *Aflatoxin management:* Two aflasafe products, GH01 and GH02, were identified and evaluated for biological control of aflatoxin in maize and groundnut in Ghana. Aflatoxin resistant groundnut varieties were identified in Ghana and Mali.

- Improved livestock feeding, health and housing, and management systems were developed.
- *Improved housing for poultry*: A study compared the intensive and free range rearing of poultry. Birds provided with housing were 43.5% heavier, and recorded lower mortality rate (19.5%) than their free range counterparts at 15 weeks of age.
- *Artificial brooding of guinea fowls*: An on-farm study showed that artificially brooding guinea fowls for nine weeks before selling to farmers could improve the rural guinea fowl industry because it reduced mortality by 15% and resulted in higher gross margins.
- *Improving village sheep and goat flocks*: An on-farm study tested a formulated feed and health package for village sheep and goat flocks with the farmers' practice. The improved feed and health package resulted in significantly higher weight gains, birth rates, more quality manure (32%) and female lambs/kids (33%), and 27% more profit per animal.
- *Feeding system for pigs and poultry*: Improved feeding packages were developed for pigs and guinea fowls.

In Ethiopia, the project has implemented more than 30 research protocols (16 exploratory and 17 action-oriented) focused on improving food security, nutrition and health, and income generating capacity of the target households through SI. The project's research outputs have been associated with clear biophysical, economic or social benefits to stakeholders. In addition, there is evidence that implementing these research-derived innovations can lead to measureable development outcomes and that they are suitable for scaling via appropriate development partnerships. Some of the integrated technologies are being tested for uptake and adaptation at pilot scale include:

- **Crop production yield gaps closed**. In Ethiopia, Africa RISING technologies have been used as a basis for regional benchmarks in crop production which sees a potential scaling domain of several million households. Collaborators in the Tigray zonal and woreda office of agriculture were initially sceptical as to the yields achieved (e.g. up to 9.4 t/ha for wheat on demonstration plots and 8.6 t/ha under farmers management conditions). The highest yield (6 t/ha) and quality seed of faba bean were also recorded in Africa RISING site in Tigray. However, they have been active partners since the project's inception and this close engagement and familiarity gave them confidence to adopt these yields as best practice benchmarks.
- **Viable approaches for community seed supply**. In Ethiopia, farmers that participated in community seed multiplication, e.g. potato, have been able to produce enough to sustain their annual food demand and make sales to generate more income. Some farmers in the Endamehoni and Sinana sites have sold potato seed and bought water pumps and carts to provide services and generate additional income.
- **Seasonal livestock feed gaps closed**. In Ethiopia, the attitude of farmers on the production of improved animal feed is changing dramatically. Farmers have started allocating much larger land areas (>0.25 hectares) to produce oat/vetch mixtures for animal feed. The oat/vetch mixtures are a source of nutritious feed in a cereal crop residue dominated feeding system and have been found to be a potential rotational intervention to break mono-cropping and disease infestation.
- **Fertilizer recommendations fine-tuned**. In Ethiopia, research examined crop responses to various combinations of fertilizer blends in the wheat-based cropping systems. It was possible to identify soil-specific best fertilizer blends and rates for wheat in target eight research kebeles. New recommendations boost yields by 200–

300%, even in previously 'non-responsive' soils. This research into targeting of micro-nutrients in fertilizer has catalysed a new national initiative to deliver these innovations countrywide.

- **Soil losses reduced and productivity improved at landscape scale.** In Ethiopia, implementation of integrated soil and water conservation practices at landscape scale reduced soil loss by over 80%. At plot level, management practices implemented at cultivated fields reduced soil loss by 87% compared to non-treated plots. Improved water lifting technologies enhanced farmers ability to irrigate high value crops and improve household nutrition. Irrigated fodder biomass increased by 14% dry weight when farmers were guided in their irrigation practice by wetting front detectors.

Partnerships

In Ethiopia, the project adopted an inclusive approach to partnership formation and support. One of the successes of the project's first phase was the strength and breadth of its partnerships (from farmers to research and development actors). These partnerships are already starting to take the project to scale and Africa RISING Ethiopia will continue to support and expand them into phase II. Experiences in partnership 'management' will stand the project in good stead for more intensive partner engagement that the approach proposed for phase II will require.

In West Africa, involving national partners, particularly the leading national research institutions, is necessary for the sustainability of the research beyond the lifespan of Africa RISING. However, these institutions need a lot of technical, managerial and infrastructural support that goes beyond the capacity of a single project. Here, concerted action is needed by all actors that partner with these institutions to have a lasting impact.

In East and Southern Africa, research partnerships made positive strides towards fulfilling the project objectives to develop strategies and initiatives that will help smallholder farmers address poverty, hunger and environmental degradation. Participatory and multidiscipline research was operationalized to facilitate: (i) the implementation of baseline studies that generated a critical mass of data and information that is available to guide prioritization, planning and implementation of phase II; (ii) technology transfers that addressed immediate and obvious cause-effect situations; and (iii) the generation of scientific evidence necessary to define technology packages that address more complicated relationships requiring the integration of multi-discipline practices. Partnerships were initially formed at site level, two in Tanzania and one each in Malawi and Zambia. These partnerships involved other institutions, especially public and NGOs at district level, and also engaged other stakeholders through the facilitation of R4D and/or innovation platforms for the purposes of stimulating stakeholder engagement, collaboration and collective action.

Capacity development

In East and Southern Africa, 2 undergraduate, 24 MSc and 7 PhD students have been attached to the project for their research work. Partnership with Innovative Agricultural Research Initiative (iAGRI), also a USAID-supported activity, facilitated mentorship of some of the students by Africa RISING scientists in Tanzania. The project has organized short-term training and knowledge sharing fora for more than 1000 stakeholders annually; these include officials from partner research and development organizations, public institutions and lead farmers. The partnership with NAFAKA is expected to raise this number more than 10-fold during 2016.

In Ethiopia, the project has supported formal higher-level training for long-term capacity development through the attachment of 30 MSc and PhD students to its research protocols. Some of these students are now writing up their research and their findings will strengthen that conducted by the Africa RISING partners due to its focus on more specific issues related to SI processes.

In West Africa, more than 4000 participants comprising farmers and agricultural extension agents benefited from various short-term group training conducted by the project. For example in Mali, cluster-based nutrition field schools were initiated in Sirakele and Mpessoba which trained more than 500 women, mostly pregnant and nursing mothers, on nutrition of children between 6–24 months. A total of 24 graduate students (17 MSc and 7 PhD) have been attached to the project for their dissertation research. Short-term courses on experimental design and data analysis and integrated crop–livestock production were organized to develop individual and institutional research capacities, with a special focus on early-carrier women scientists.

R4D and innovation platforms

It was believed that R4D and innovations platforms would play a key role not in setting research priorities and mainstreaming research outputs, but for all research and development activities occurring within their constituencies. To this end R4D platforms were initiated in Ghana, Mali and Tanzania with the intention that they would gradually become independent and able to self-manage and raise funds for meetings and activities.

The R4D platform in Tanzania's Babati district was inaugurated in April 2014 and is contributing to the adoption of new sustainable farming technologies. It has proved to be useful in stimulating learning and innovation, e.g. in training farmers and extension staff in forage production and post-harvest management. It has also created significant income generation opportunities, such as in vegetable production and improved chicken feeding practices.

Since its inauguration, it has managed to rally stakeholders involved in agricultural development in the district, who have developed a constitution embodying its mission and vision and a detailed plan of activities. In addition, the platform has been able to nurture a sense of ownership and sustainability among important stakeholders within the district.

For instance, the Babati district council—the key government administrative unit for agricultural development in the area—is committed to funding its management and operations in 2016/17. With support from Africa RISING, several ward-level platforms are currently being established to ensure more farmer participation in priority setting and to increase their access to innovations. Innovation platforms have been established in Kongwa and Kiteto districts which are aligned with the districts' vision.

In Malawi, the project reinforced existing platforms already embedded in the Agricultural Extension and Coordination Committees of Ntcheu and Dedza districts. The project, though, has encountered some challenges pertaining to the operationalization of these platforms. They should be a mechanism for research priority setting, and dissemination and scaling of Africa RISING outputs. The Ethiopia project established and operationalized eight kebele level and four woreda/district level innovation platforms for the purposes of cross learning, planning and evaluation. Eight district-level R4D platforms were established—two in Koutiala and Bougouni in Mali and six in Ghana, two in each of the three regions.

However, better understanding of the added value of R4D platforms under different conditions is still needed. As with many open-ended processes, insight is lacking as to what exactly makes them effective in changing mainstream practices depending on policy environment, the range of issues involved or the scales (e.g. strategic, operational) at which the platforms operate. If long-term platform sustainability is not likely, it may be better to set up less complex platforms around specific project interests for a limited period of time, something like multi-stakeholder working groups.

For instance, in West Africa, 'technology parks' were identified for technology validation, awareness creation, farmer capacity building and collective action. They provide an important meeting point where researchers and farmers work together, thus contributing to a better understanding of the research by the farmers and providing an opportunity of direct feedback from farmers to researchers. The communities are very interested in these parks and there is good sense of ownership, at least from those farmers participating actively in the trials. In addition, they are ideal for farmer field days as a broad range of technologies can be demonstrated at one place. Within the parks, the project focused on validating crop-related technologies neglecting the integration of technologies in support of livestock intensification, such as feeds.

Actors in the platforms assisted with the identification of constraints and opportunities for SI, research prioritization, implementation of multi-disciplinary research on SI, dissemination of options for SI, and capacity building. Phase II proposes to build its continuity on the established partnerships, but also ensure close collaboration among research teams within and between countries in the implementation of the proposed research activities, (see section on communities of practice).

Scaling

The West Africa project used different approaches to demonstrate, deliver and scale-out technologies to more than 4000 farmers. They included participatory 'mother-baby trial', 'community-based technology park', farmer field days and R4D platforms. In Mali, links were established with development partners and development projects to disseminate SI technologies. For example, a total of 1463 male (45%) and female (55%) participated in pre-harvest farmer field days in the intervention communities in Ghana in 2014. Some specific technologies were disseminated to a wider group of beneficiaries such as the *Fighting Striga* videos which were translated into six north Ghanaian languages and 5000 DVD were produced and distributed in Ghana.

In East and Southern Africa, scaling took place through research and private/public institutional collaboration (Tanzania, Malawi). The partnership approaches in the two countries have the potential to extend Africa RISING reach to about 100,000 households, delivering selected technologies and knowledge from project output research, by the end of 2017.

Communications and learning

During phase I, Africa RISING published numerous blog posts (http://africa-rising.net), reports, evidence briefs, posters and brochures, highlighting the work of the project and communicating its findings to potential users and beneficiaries. All information products are documented in the program's open access repository. Data is captured in an ILRI-hosted repository. A wiki supports ongoing collaboration—it provides a workspace for ongoing work, as well as documenting the hundreds of events and workshops held by the program.

Statistics on the use of the various platforms and services show growing uptake (see tables below).

Outputs registered in the repository

	2016	2015	2014	2013	2012	All time
Brief	0	29	10	3	0	42
Brochure	0	0	2	4	1	7
Case study	0	1	0	0	0	1
Conference proceedings	0	0	0	1	0	1
Extension material	0	1	0	0	0	1
Internal document	0	0	1	2	1	4
Journal article	7	7	2	1	0	10
Manual	1	1	2	0	0	3
News item	0	0	0	0	3	3
Newsletter	0	0	1	2	0	3
Poster	26	11	3	0	1	15
Presentation	10	42	59	43	48	192
Report	14	51	57	19	75	207
Thesis	3	1	1	0	1	3
Video	0	2	2	4	11	19
Working paper	0	0	1	0	0	1
Total	61	146	141	79	141	512

Summary statistics report for Africa RISING web communication

	2016	2015	2014	2013	2012	All time
Website						
Posts	34	116	83	37	69	339
Views	17,379	46,837	37,512	16,620	10,397	128,745
Views/post	511	404	452	449	151	380
Wiki						
Edits		1,420	1,131	604	1,272	1,876
Views		100,879	78,480	54,717	39,591	94,308
Visitors		34,298	40,375	37,218	22,821	60,039
Repository						
Items added	61	146	141	79	141	512
Views	49,695	76,519	64,920	60,565	47,247	298,954
Downloads	88,171	123,909	87,656	79,231	48,356	427,332
Views and downloads	137,866	200,427	152,575	139,796	95,603	726,286

In Ethiopia, the project has organized a series of field days, knowledge sharing fora and short-term training workshops. For the period 2013–2015, the project recorded almost 11,000 participants in these activities.

The project's work in Ethiopia has generated significant media coverage at both national and regional levels. For instance, project work on introducing a two-wheel (single axle) tractors to power agriculture in the highlands of Ethiopia and further unlock the potential for SI was intensively covered in the national press.

The Ethiopia project gained recognition by USAID for its work in collaboration and learning.

Lessons on program implementation

In 2015, PCT members identified strengths and weaknesses of the program as part of an internal review process (these were informed by the internally-commissioned external project reviews at that time).

Strengths

- Focus on systems-based and integrated research (as opposed to a single technology); simultaneous focus on different farming-livestock systems; brings together national and international researchers, active involvement of the donor.
- Space given to projects to manage and innovate, responsive to emerging issues, collaborative mode of interacting with donor, dynamic project design process, continuing dialogue amongst projects.
- Farming systems approach to testing, adapting and dissemination of SI options; trans-regional; Public/private partners and strong institutional capacity that can contribute to change; increasing interest of governments and donor agencies in intensification; opportunities to link-up to other FTF development projects for impact.
- 'Enforcement' of data capture, archiving and sharing; learning and exchange across the projects; networking with research and development partners; annual learning events and M&E meetings; the program provides lots of opportunities for cross-learning.
- Almost all-encompassing research carried out (crops, livestock, soils, water, markets), spanning different agro-ecologies and farming systems.

From specific regional projects

- In Ethiopia: Genuine partnerships across the board, well-focused on real problems and solutions (gives strong farmer engagement), good R4D partnerships with real on the ground involvement from local development partners, emerging findings are genuinely relevant, good targeting initially is starting to pay dividends in terms of spontaneous scaling.
- In Ethiopia: Farm-level and landscape/watershed-based research; strong partnership with CGIAR centres, local universities, research institutions, extension, NGOs, farmers and private entrepreneurs; placement of site and assistant site coordinators at site level to strengthen linkage and facilitation with local and CGIAR centres, and implementation of research initiatives on the ground; establishment of 12 innovation platforms that enhance innovation, communication and cross learning.
- In West and East and Southern Africa: Mother-baby trials; applied research on water and fertilizers; Communication.
- In East and Southern Africa: Partnerships and collaboration that have grown to appreciate the concept of integration for intensification; strong bio-physical

research; on-farm development of technologies with mother–baby as the preferred approach; links with USAID-supported development programs, and gradually with the private sector (notably seed companies).
- In West Africa: broad partnerships in Ghana; Technology testing and adaptation.
- In East and Southern Africa: Very broad partnerships; good integration of national programs in Tanzania; strong capacity building component; USAID mission in Tanzania interested in Africa RISING work and providing funds for scaling certain mature technologies; project very visible.

Weaknesses

- Diverging visions on Africa RISING aims; program framework too broad to provide practical guidance at project level; insufficient level of harmonization within and across projects; unclear feedback mechanisms for sharing experiences and how the latter should feed into the design of better research projects; inadequate monitoring through measures and indicators beyond the FTF indicators; not tapping sufficiently into the cross-learning opportunities; visibility still to be improved; alignment with USAID mission priorities and activities could be stronger; program boundaries not clearly defined–there is the temptation to do everything.
- Including social scientists to advise biophysical researchers from the beginning of the project would have allowed for more gender-sensitive research planning and data collection.
- Africa RISING needs to be more rigorous in the socio-economic assessment of technologies and consider different farmer typologies to come up with options that really work for specific farmers.
- The program needs to communicate more intensively its research outputs to potential 'clients' beyond the Africa RISING, i.e. to the development agencies so as to ensure that they reach a significant number of beneficiaries.
- Insufficient attention to research output three on scaling; in some countries, engagement with national agricultural research systems (NARS) is weak; some projects weak on social and economic research; limited capacity of some key partners; livestock and post-harvest components not always covered; insufficient effort to consolidate various farming systems/ site diagnostic/characterization study findings.
- In East and Southern Africa: Data are generated more at mother than baby sites (testing adaptation and spill-overs are important aspects of technology acceptance and are best done at baby sites); typology-based research has yet not been fully adopted; researchers present sets of technologies to all at the demonstration sites and have not yet followed up to determine which typologies chose which technologies; landscape-based research is still a challenge; more work is done at plot level; the platforms need resources and dedication; communicating recommendations is weak (scientists shy away from committing to a 'completed' technology or 'completed component (sequencing)' of the technology.

Implications

- Use research as the engine for driving innovation, but build a layer of scaling partnerships on top of this.
- Identify promising discrete technologies to be scaled up in specific areas, to allow for rigorous impact assessment.
- Boost: socio-economic research to ensure that technologies are viable for different farm typologies; documentation of technologies that work for different farm types including their associated risks; livestock integration; activities resulting in short-

term effects on soil and water; data sharing and joint publications; strengthening of R4D platforms; nutrition-related activities; collaborative and model landscape level research; IP initiatives; cross-learning visits; M&E at project level; packaging of 'mature' technologies for delivery and scaling; ecological measurements—usually at landscape scale; research on reducing product wastage (post-harvest management and value addition) which saves as much as is increased through agronomy; time and effort to carefully and systematically synthesize findings and results.

- Stop: more surveys for situation analysis, we have enough data that now needs to be acted upon and made accessible.

Annex 2: Sustainable intensification indicators framework

Drawn from a document by Mark Musumba, Cheryl Palm, Philip Grabowski and Sieglinde Snapp

What is sustainable intensification?

Sustainable Intensification focuses on improving the efficient use of resources for agriculture, with the goal of producing more food on the same amount of land with reduced environmental or social impacts. The term "sustainable intensification" originated in the 1990s in the context of how to achieve improved yields over the long-term in fragile environments of Africa (Pretty 1997; Reardon et al. 1995). Intensification has the potential to reduce pressure from population growth on the conversion of natural lands to agriculture (Cook et al. 2015). Unfortunately, sustainable intensification has become somewhat of a buzzword that is often used to describe any type of agricultural intensification that may have some potential environmental benefit (Godfray 2015). Sustainable agricultural intensification should not be viewed as a particular set of practices but instead provides a conceptual framework for guiding discussions on achieving balanced outcomes of intensification (Garnett and Godfray 2012). Thus, there can be alternative pathways to sustainable agricultural intensification which will vary by location and scale, depending on agro-ecological zone, farming system, cultural preferences, institutions and policies, among other factors. Each of those pathways will have a different set or levels of environment and socioeconomic trade-offs and/or synergies.

Research on sustainable intensification (SI) needs to be interdisciplinary, drawing upon the theories and methods of the biophysical and social sciences. Recent SI work has a major emphasis on crop management strategies that can reverse land degradation and reduce yield variability despite climatic changes (Dahlin and Rusinamhodzi 2014). Much of this SI research focuses on environmental aspects of sustainability using biological and ecological principles to improve the ecosystem services of the farming system and reduce the environmental problems associated with it (Petersen and Snapp 2015). However, environmentally sound and economically profitable production practices may ignore the complex social dimensions of sustainability. SI is often presented as a solution to food insecurity and malnutrition and therefore must consider the distribution of benefits from improved production, with more attention given to equity, poverty alleviation and gender empowerment (Loos et al. 2014). Ignoring these aspects can threaten the sustainability of enhanced production. For example, food insecurity can cause farmers to sell off productive assets to meet their basic needs and thus compromise their ability to maintain productivity levels. Even if one defines agricultural sustainability without these social elements there is widespread agreement on the desirability of working towards their improvement, and responsible agricultural development should seek to enhance and not hinder the multiple goals of sustainability.

The sustainable intensification indicator framework

Purpose of the SI indicator framework

A number of indicators have been used and recommended for assessing sustainable agricultural intensification (Lopez-Ridaura et al. 2005; Speelman et al 2007; ISPC 2014; Smith et al. 2016) but limited number of studies (Smith et al. 2016) have explicitly explored the

gaps and needs of scientists working in research for development projects in reference to sustainability indicators.
The sustainable intensification indicators framework described in this document aims at providing a synthesized list of agricultural intensification indicators and metrics that can be used for assessing the degree or trajectory of sustainability of agricultural intensification efforts. The indicators and metrics are categorized into five domains (productivity, economic, environmental, social and human condition) and three scales (field farm/households, and landscape) from which researchers and stakeholders can select those most relevant to their programs. The list of indicators builds off of previous compilations (Speelman et al. 2007; ISPC 2014; Zurek et al. 2015; Smith et al. 2015), as well as several meetings and consultations organized by USAID.

The framework is mainly intended for use by agricultural scientists working in research for development projects but is flexible and can be used by scientists interested in sustainable intensification more broadly. It is not intended to fit all requirements or replace other efforts to develop SI indicators, but rather to provide a common framework that can guide research on SI and facilitate cross-program learning and assessment on the factors that lead to increasing sustainability.

The framework is developed to provide a knowledge base on indicators and metrics. The SI indicator framework includes both 'gold standard' approaches to assessing SI, as well as, simplified methods and metrics as options that are feasible to use considering the spatial, temporal and cost limitations. It can be used to analyse the performance of intensification interventions by comparing the most relevant indicators with the status quo practices. The SI indicators framework can also be used to quantify relative sustainability trajectories by comparing indicators from several domains across time and/or space and also between "treatment" and "non-treatment" groups. SI indicator metrics can be presented through visualization techniques such as radar charts to compare performance of innovations or interventions, or for a range of environmental contexts where an intervention has been implemented.

The framework also presents opportunities for analysing SI interventions (technologies, management practices, policies) within the context of broader farming and livelihood systems. For example, researchers can carry out thought experiments to consider how the various indicators listed under each domain might be affected positively or negatively by an intervention that they are investigating or planning to research. This qualitative assessment should be informed by the scientific literature as well as by discussions with farmers, fellow researchers, NGOs or other stakeholders about the potential direct and indirect effects of a SI intervention. This would help researchers to anticipate potential synergies and tradeoffs and minimize unintended negative consequences by mitigating them through the research design. (An example of such 'thought experiments' is given in Appendix 1 on Assessing Tradeoffs and Synergies).

The SI indicators framework could also be used to guide monitoring and evaluation efforts in development projects. All of the key concepts and methods to measure or estimate the indicators are presented in the framework. Several considerations would be needed to effectively consider the effects of scaling up or aggregating plot and household level indicators to a larger scale of analysis so that the project-level effect can be estimated (such as at the village, watershed or sub-district level). Nevertheless, the same process for choosing the most relevant indicators and reflecting on synergies and trade-offs could be applied to M&E for development projects.

The overall goal of the SI indicator framework is to provide research results that communities, scientists, implementation partners and policymakers can objectively evaluate with explicit linkages across potentially competing sustainability goals (e.g. biodiversity conservation, agricultural production, food security, and gender equity).

There are challenges for assessing some indicators and using the SI indicators framework in a research context. Often research on agricultural technologies is conducted with a small number of farmers and on small sized plots on these farms. A number of assumptions will need to be made when considering the potential impact of expansion of the technology on a farm and the widespread use of the technology in a community and landscape. Although many of the biophysical indicators and methods are well known and can be scaled to some extent, the methods for assessing the scaling of an intervention on the economic, social and human indicators are more complex. Various types of qualitative research and modelling may be useful for this purpose. This quantitative use of the framework can be complementary to adoption studies by considering the performance of the technology holistically.

Five domains of Sustainable Intensification

To facilitate the organization of the various dimensions of sustainability, the indicators of sustainable intensification have been classified into five domains: productivity, economic, environment, human condition and social. Categorizing the dimensions of sustainability into these domains was based on defining the particular domains through discussion with scientists and previous literature on the subject. The assignment and choice of domains may have some level of ambiguity as some indicators may have characteristics that would place them in more than one domain. For our purpose, the domains are described and organized as follows:

Productivity: This domain focuses on productivity of the land as a key concern in the context of growing populations, land degradation and threatened biodiversity from loss of natural habitat. Intensification focuses on increasing the productivity of any input (such as labour), these input indicators are captured in the economic domain.

Economic: This domain focuses on issues directly related to the profitability of agricultural activities. In addition to profitability itself this domain includes indicators related to the productivity of inputs other than land (water, nutrients, labour, capital) as well as indicators likely to affect the probability of investment in enhancing productivity (market participation). Finally, poverty rates are included in this domain as they can be directly affected by increased profitability.

Environment: This domain focuses on the natural resource base for agriculture (soil, water), the environmental services directly affected by agricultural practices (habitat) and the level of pollution coming from agriculture (pesticides, greenhouse gases).

Human condition: This domain contains indicators that pertain largely to the individual or household, such as their nutrition status, food security, and capacity to learn and adapt. These concepts are certainly dependent on social interactions but are distinct from those in the social domain which directly focus on inter-personal relationships.

Social: This domain focuses on social interactions: equitable relationships across gender within the household, equitable relationships across social groups in a community or landscape, the level of collective action and the ability to resolve conflicts.

Scales of analysis

Measuring indicators for assessing sustainable intensification typically requires observing parameters at various scales. The framework includes four scales of analysis – plot level, farm level, household level and the "landscape or administrative unit" scale (which could include community, watershed, a district, province or even nation). Focusing on only one scale can be useful for focused analyses but caution is necessary as ignoring lower or higher scales may result in missing trade-offs not detected at the scale of interest. Also focusing on only one scale fails to consider important interactions across scales.

Approach used to refine sustainability indicators

To develop a flexible framework, we explored the literature and interacted with scientist to obtain a list of critical indicators and then analysed them for their precision and their easiness to measure. We also carried out field visits to interact with scientists and stakeholders (farmers and project partners) to obtain insight in the process of stakeholder engagement, data collection, indicator generation, and perception by participants in the process.

A suite of indicators has been proposed and included in the framework from our visits and interactions with scientist that include:

- Africa RISING meeting with steering committee members
- Africa RISING Project in Mali and Millennium Villages Project in Mali.
- Africa RISING project sites in Ethiopia
- Interaction with scientist at the annual meeting for the sustainable intensification innovation lab (SIIL)
- CIALCA project in Rwanda

This process has enabled the identification of data and indicator gaps. In situations where data gaps exist, we are proposing data collection methods to fill this gap. Where new indicators are proposed, we plan to present those indicators to experts to provide information on their relevance and measurability. A similar approach has been used by earlier studies (Zurek et al. 2015; Taylor et al 1993; Van der Werf and Zimmer 1998) to refine indicators in situations where no other possibility of validation exists (i.e. a new indicator is proposed but with no data to estimate it).

Initial list of priority indicators

It is important to consider which indicators experts feel are of high importance (priority), relevance, and are measurable (precision and cost). The final selection of a priority list of indicators will be obtained through a survey of researchers. For now, an initial list has been developed through a small exercise with scientists during the SIIL annual meeting in Kansas, where they selected indicators that were of top priority to the six SIIL projects (Table 7). Indicator selection depends on context, project objective, and other associated costs of data collection and implementation.

Table 7. Indicators selected by SIIL researchers in terms of relevance to the project objectives[1]

Productivity	Economic	Environment	Human Condition	Social
Yield (4)	Profitability (4)	Partial nutrient Balance (3)	Nutrition (5)	Equity (age, gender) (4)
Fodder production (3)	Market Participation (2)	Soil Quality (3)	Food Security (2)	Level of collective action (2)
Cropping Intensity (2)	Limitations to land, labour capital (2)	Soil Carbon (2)	Food Safety (2)	Conflict over resources (2)
Yield variability (2)	Variability of profitability (2)	GHG emissions (2)	Nutrition awareness	Child time use (to ag.)
Animal Production (2)	Input use efficiency	Water availability (2)	Human Health	Class equity
Animal herd composition	Progress out of poverty	Water Quality (2)		
Yield gap	Off Farm income	Pesticide use		
Variability of crop productivity		Plant Biodiversity		
Mechanization indicator		Vegetative cover		
		Soil acidity		
		Soil salinity		
		Erosion		

[1]The number in parentheses indicates the number of project out of total of 6 that picked that particular indicator from the framework

How to use the SI indicator framework

The SI indicator framework aims to be realistic for donor investment and practitioners' needs by being adaptable to specific contexts and by providing a range of measures for any given indicator: from the gold standard to feasible proxies that are less resource demanding.

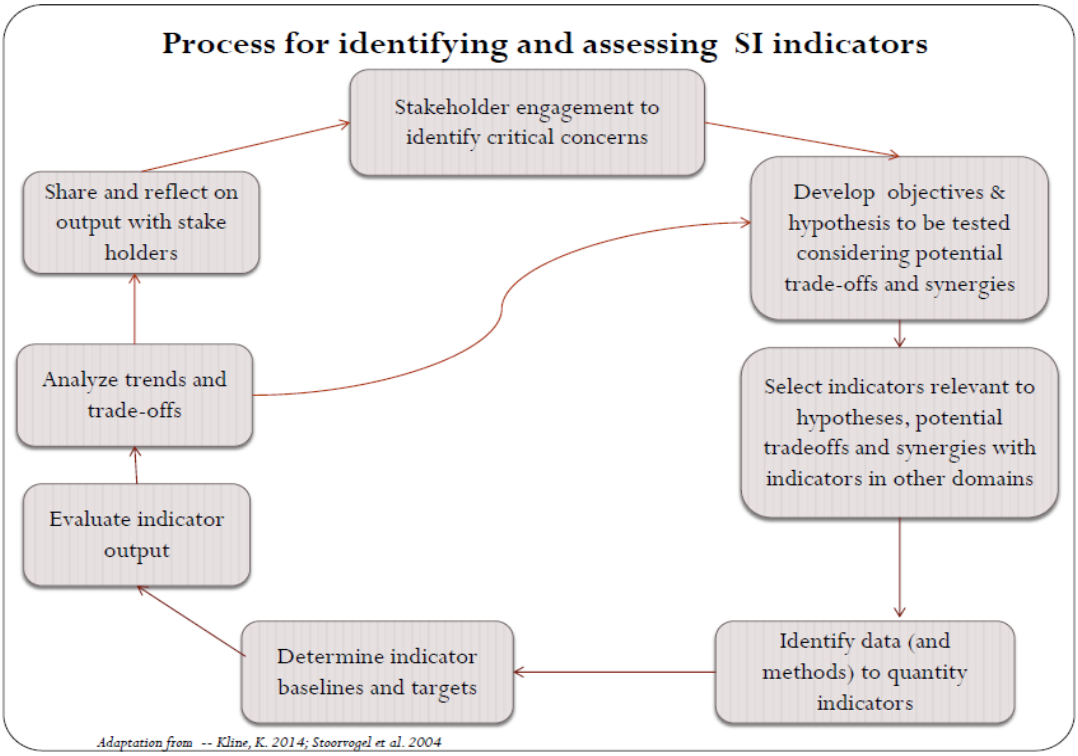
The following steps can be followed for using the SI indicator framework:

1. Engage with stakeholders to identify critical concerns
2. Consider potential trade-offs and synergies for possible interventions
3. Select indicators from each domain that are relevant or appropriate to the technology or intervention being tested and for the context where it is being promoted
4. Decide how to measure each indicator based on the overall human and financial resources available and the expected importance of each indicator in each context (priority indicators). The methods are listed in the right hand column of each table and are linked to the indicators in each row with superscript numbers.
5. Decide how to operationalize each measure, including sample size and sampling strategy
6. Collect data
7. Analyse and interpret results

8. Communicate results to the various stakeholders using appropriate techniques for each of those groups.

The results of the analysis and the critical reflection on the implications of those results by stakeholders will lead to new questions or adaptations to interventions and another round of selecting indicators (Figure 3).

Figure 3: Illustration of process of selecting indicators and presenting the output to stakeholders



Presenting indicator output

Presenting multiple sustainability indicators to an audience is complex and needs to ensure that relative changes among indicators are captured. There is debate on the optimal number of indicators that can be present on a given visual aid to prevent information over load (Miettinen 2014) but also ensure that there is a relationship between the indicators that can portray relative differences. In addition, the temporal aspect requires an illustration of change over time of given indicators and the how sustainability may be assessed relative to a given reference level.

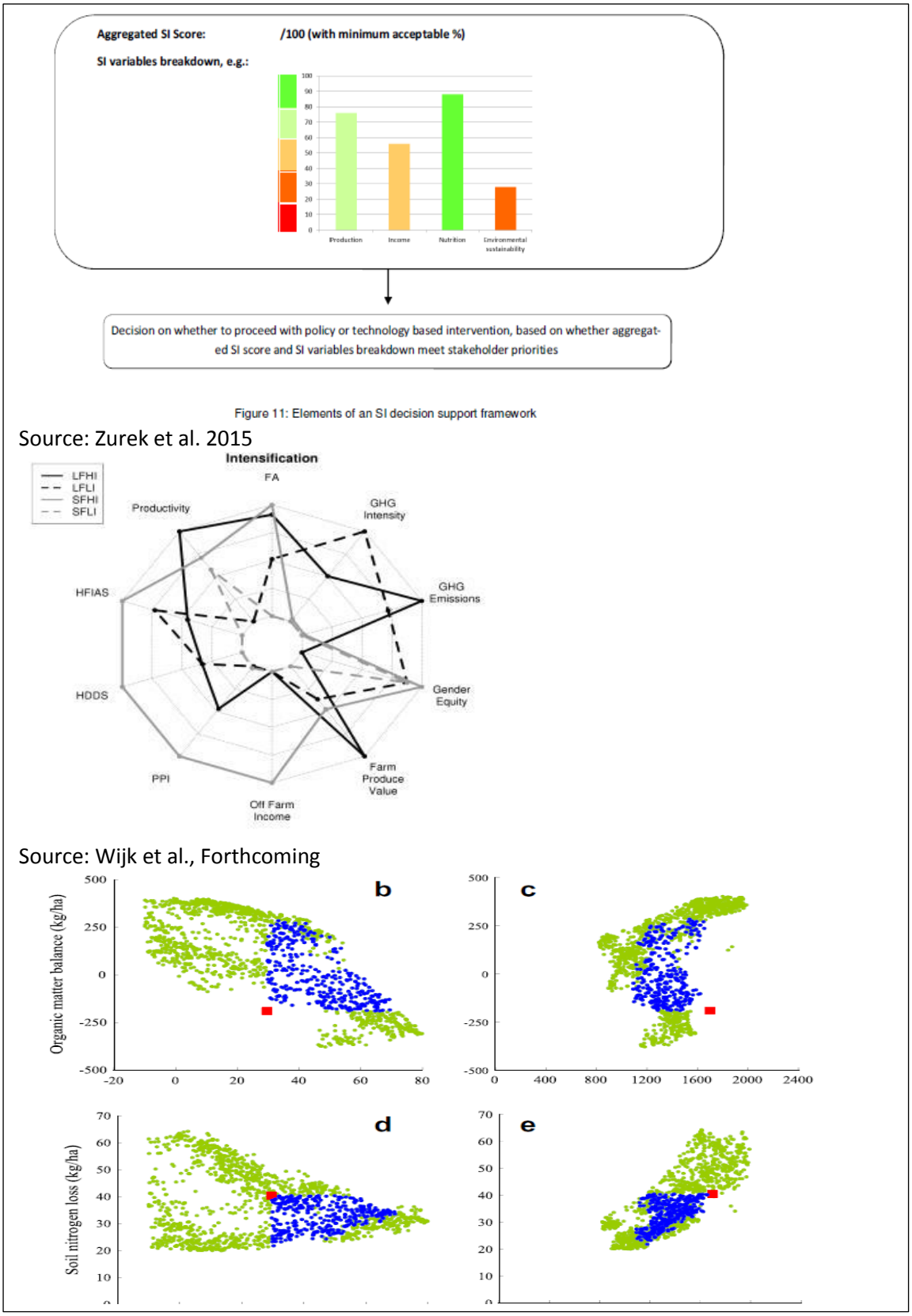
A number of studies have used various methods to present indicator output results to examine trade-offs and or relative changes using bi-plot, bar charts, radial plots, matrices, spidergrams, star-plots, and petal diagrams (van Wijk et al 2016; Zurek et al 2015; Snapp et al. 2010). Indicator output presentation may also require setting and presenting thresholds below and above which a target indicator may be 'red- flagged for either policy or technological intervention (See Figure 4 top panel).
Zurek et al. (2015) propose use of a traffic light system to indicate whether a given indicator is below of above a critical threshold (see Figure 4). In addition, farm typologies can be used to compare performance across given level of intensification. Van Wijk et al. (forthcoming)

present farm performance in Tanzania categorizing farms by size (ha) and intensification level (use of nitrous oxide emissions) (see Figure 4 middle panel). In situations with limited data, models have been used to examine trade-off and synergies using bio-economic models, like FarmDESIGN (Groot et al. 2012). This modelling work is currently being done in the CIALCA project in Rwanda but for this purpose we present an example of visual output from earlier work by Groot et al. (2012). The output indicates the farms initial endowment (red dot) and the blue dots indicate scenarios that outperform the original endowment (Figure 4 bottom panel) (Groot et. al. 2012; Kanter et al., (2016). Below we present a few examples that one may draw upon in visualizing the output from the SI framework.

Proxy indicators

Proxy indicators are those used when data or information is not observed directly (Riley 2001). Proxy indicators are used in situations where no direct measurements exist or the cost of direct measurement is too high. An example is that ownership of assets such as car, tin roof, or television may be used to estimate income levels where there is no reliable data from household income survey. A similar example is the estimation of nitrous oxide emissions in situations where only information on nitrogen use is available. A recommendation is to estimate that 1% of nitrogen used is emitted as nitrous oxide emissions (IPCC 2007). There is continuing work to determine and document available indicators from direct measurements, modelled output, and remote sensing.

Figure 4. Visualization methods for presenting indicator output.



Annex 3: Systems research examples from phase I

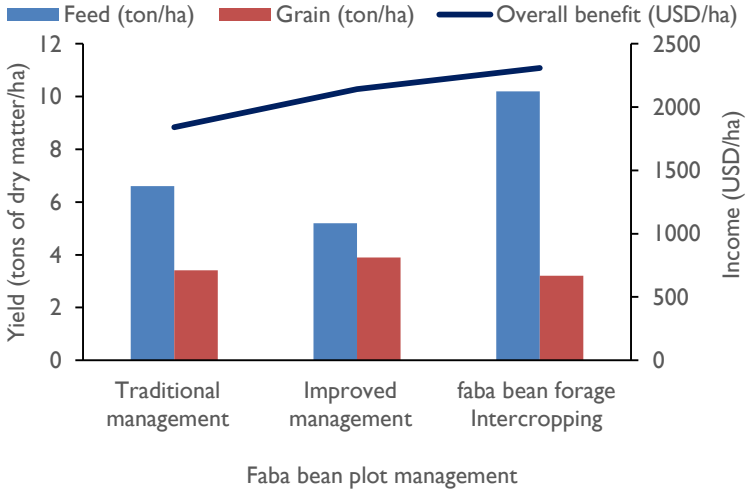
Ethiopia: Stepwise approach to sustainable intensification for faba bean/ forage production

The Africa RISING diagnostic study identified shortages of quality and quantity animal feed as a major constraint in the Ethiopian highlands to sustainable livestock production. Given the scarcity of grazing lands, farmers rely heavily on stubble grazing and crop residues as a source of feed for their livestock. During the main cropping season, when crop residue reserves are depleted and stubble grazing is unavailable, farmers deliberately weed their faba bean fields much later than recommended by those advocating improved management systems.

Late weeding creates the opportunity for volunteer 'weeds'—such as wild oats and *Trifolium* spp., species that are in fact relatively nutritious fodders—to create an *ad hoc* forage intercrop. An attempt was made to explore some possible explanations as to why farmers had not adopted improved management practices for faba bean. Africa RISING researchers examined the hypothesis that smallholder farmers did not adopt improved management practices because they did not adequately improve the overall benefits derived from traditionally-managed faba bean plots.

In testing the improved approach, the same varieties were planted. The only difference was weeding was undertaken more frequently. Removing the weeds gives the faba bean plants more space, more nutrients, water, sunlight and ultimately higher yields. However, if the weeds are removed before they flower, in the long run the seeds will be lost and the sustainability of the practice will be compromised.

Figure 5. Grain and feed biomass yields, and economic gains associated with different management approaches



An evaluation revealed that the loss in weed biomass, when the improved practices were adopted, was not adequately offset by the economic gains from increased grain yield and crop residue biomass. The analysis also showed that taking a broader systems perspective was imperative when introducing a new technology and that using the terms 'improved' and 'weed' indiscriminately—and without properly understanding the multiple benefits farmers derived from cultivating their plots—could be highly misleading.

Building on this evaluation, in a stepwise fashion, another trial was conducted. First, scientists screened for faba bean varieties which could tolerate competition for resources with improved forages. Then they assessed the suitability of introducing improved forage seeds (rather than relying on volunteer weeds) in faba bean plots through intercropping.

The results showed the possibility of obtaining an equivalent grain yield and improved feed biomass production from intercropping as compared to other practices. There was a strong indication that the incomes of farmers in the mixed crop–livestock system would increase benefit significantly if the intercropping were adopted.

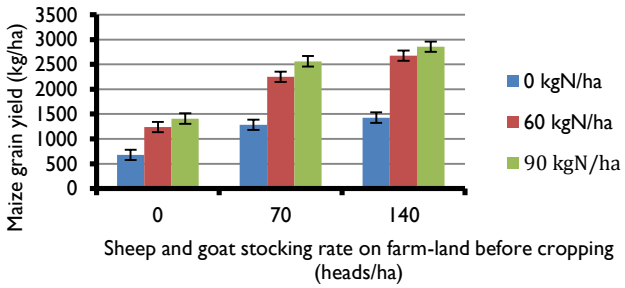
Not only are there income benefits, taking a systems approach offers feed to livestock, benefits the environment through improvements in the soil fertility and possibly nutrition through increased faba bean yields in the future. This study shows farmer practice is attuned from the systems perspective, and the pathway to a successful intensification of the faba bean-based mixed farming system appears to revolve around choosing competition tolerant variety and forage combinations that optimize production grain for human consumption and feed for livestock.

Ghana: Integrated crop–livestock research, a whole-farm approach

Seeking to offer solutions to farming communities in Ghana, multi-disciplinary Africa RISING teams adopted a whole farming system research approach in 25 communities in the country to develop an understanding of farm-households, their environment and the constraints facing them. Key to the success of the approach was the dissemination of promising solutions to other farm-households in similar situations. The researchers began by undertaking community and farming systems analysis to identify and prioritize biophysical and socio-economic constraints, opportunities, coping strategies and entry points.

Community-level research-for-development platforms were then established. In liaison with farmers and farmer interest groups, the researchers and extension staff developed community work plans to address the constraints faced by the farmers. The work plans comprised activities to improve the whole farming system: crop, livestock and integrated crop–livestock production; soil and water productivity; household nutrition; food storage and safety; and value addition. The work plans were subsequently implemented by multi-disciplinary research teams and extension staff—with a high level of farmer participation—to evaluate and identify single and/or combinations of sustainable intensification technologies/practices to improve production per unit of land.

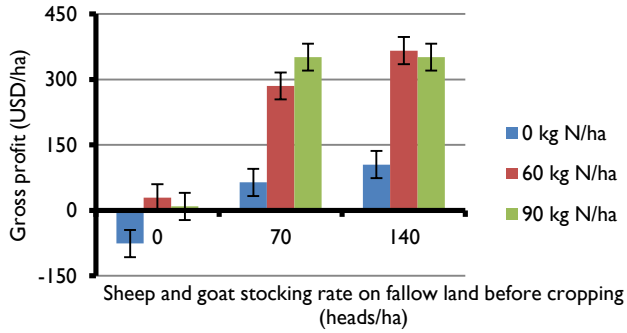
Figure 6. The effects of sheep and goat stocking density and nigroten fertilizer rates on maize grain yields in northern Ghana



The 'community-based technology park' approach was adopted to address constraints related to low crop yields on farmer fields which is associated with several factors including limited access to improved technologies, inappropriate agronomic practices, and poor delivery systems. The technology parks consisted of researcher- and farmer-managed trials (5–20 trials depending on the park size) to evaluate and identify single and/or combinations of technologies to improve crop production, and land/soil and water productivity; as well as improve the level of integration of the activities of crop–livestock enterprises.

The parks facilitated co-learning by farmers and researchers. Extension staff, farmers, researchers and students engaged in hands-on trials, while the parks also offered opportunities to demonstrate and disseminate improved/new technologies/practices to participating and non-participating farmers through farmer field days, farmer field schools and exchange visits.

Figure 7. The effects of sheep and goats stocking density and nitrogen fertilizer rates on profits from maize grain production in northern Ghana

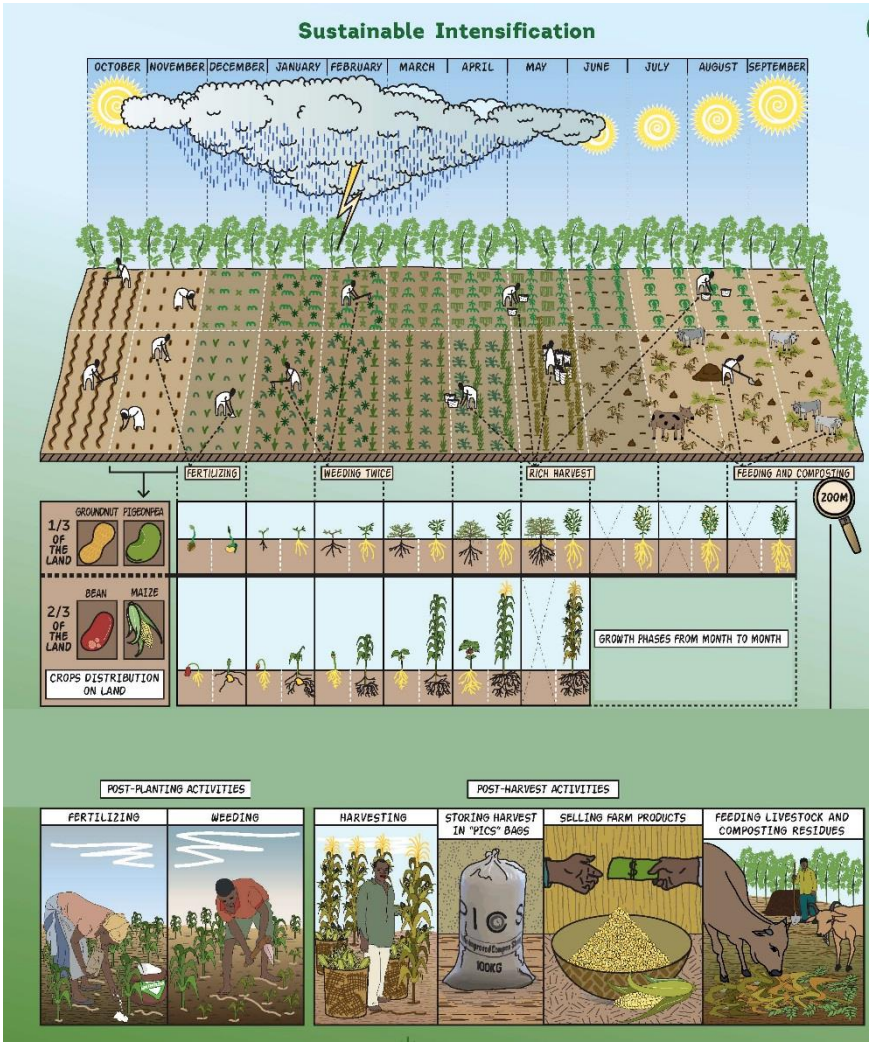


Figures 6 and 7 illustrate the findings from one on-farm trial, testing a combination of sustainable intensification technologies to refine an integrated cereal–livestock practice for small-scale mixed farming systems in the Upper East region of northern Ghana. The findings show a positive interaction between keeping small ruminants on fallow lands overnight (5pm–5am) and nitrogen fertilization rates on maize grain yields and profit from growing maize on the fallow land. The increase in maize grain yields associated with increasing small ruminant stocking density could be partly due to the increase in the soil chemical and biological properties, and a decline in the physical properties due to leaving the sheep and goats on the field. Higher profits earned with increasing stocking density and nitrogen fertilizer rate could be due to the observed higher grain yields. The findings stress the need to consider combinations of technologies/practices and how they interact with each other in designing farming systems research.

Malawi: Establishing sustainable intensification practices, doubled-up legume technology

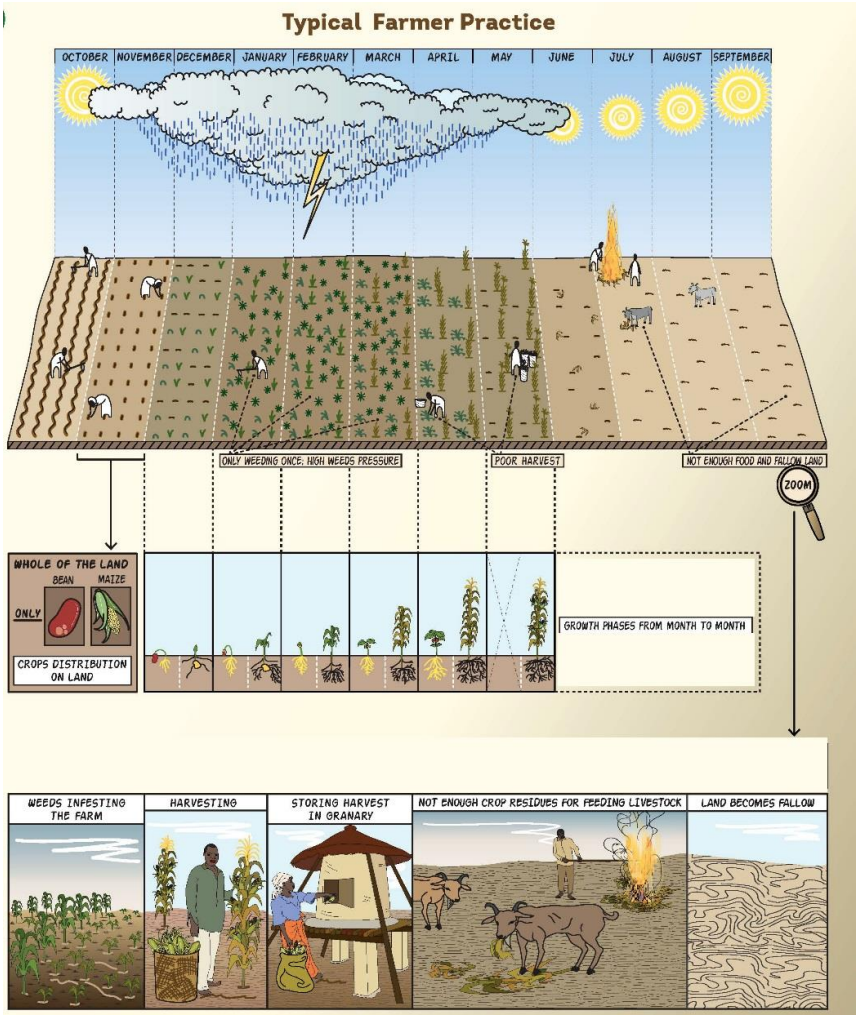
Smallholder farming households in Malawi are distinctly diverse within and across communities. In this example, technological interventions to address the problem of poor productivity of smallholder agricultural systems were designed to target socially diverse and spatially heterogeneous farms and farming systems. Agricultural technologies were developed to assess farm characteristics and the ability of farmers to invest, access resources, and attain the requisite inputs.

Over the last four cropping seasons, the AFRICA RISING team conducted field research on farming systems in Malawi and opportunities for sustainable intensification. The insights gained were then used to develop an intensified farming system that taps into both good agronomic practices and the benefits of improved seed technologies to result in productive farms (infographic A). This infographic helps to visualize what sustainable intensification means in the context of the farming systems in central Malawi, as opposed to the current typical farmer practices (infographic B).



From the limited land available, family farms practicing sustainable intensification harvest two extra legumes (pigeonpea and groundnut) in addition to maize and beans. This allows them to ensure better protein supplementation in their diets. They also use improved post-harvest storage technologies like improved bags that limit pest-related losses. They can therefore take their produce to the market at the right time when supply is low and make a profit. Sustainable intensification ensures that everybody on the farm wins; the cows and the goats have the maize stover and fodder trees to feed on and in return they give the farmer manure for healthy soil.

In infographic A, a sustainable intensification approach is adopted. The intercropping (groundnut/ pigeonpea and maize/beans) provides a scope to 'expand' the limited land while concurrently making it feasible to produce multiple crops to meet farm production objectives. It has 'doubled-up' legume and 'double' soil fertility benefits from biological N2-fixation. Only limited fertilizer is required due to the organic nutrient resources locally generated and recycled on farms. The two extra legumes (pigeonpea and groundnut) act as green manure by offering biological N2 fixation thereby raising the future production potential of the farm. Weeding is undertaken twice by the farmers.



On the typical farm (infographic B), the germination success rate is limited due to low N2 fixation because beans are the only legume planted. The growth of maize is stunted due to nutrient deficiency in the soil and no fertilizer is applied. The typical smallholder practice is characterized by: sole maize and beans intercropped, low plant population due to soils with low organic matter, the farmer rarely applies any fertilizer, high weed pressure because the farmer only weeds once, low crop yields, storage techniques that are vulnerable to pest attacks and fallow land during the off season, thereby culminating in another unproductive year for the farmer.

The key elements of the success of the intensified options for improved productivity in Malawi included the:

1. Narrowing of the inter-ridge spacing between the planted crops from >0.9 to 0.75 m. This optimizes plant densities as suboptimal densities are a major source of reduced yields;
2. Recycling of nutrients on farms where farmers feed the crop residues to their livestock which in turn produce manure for the crops;

3. Use of improved germplasm of both grain legumes and cereals, and mineral fertilizers; and
4. Integration of the shrubby pigeonpea with other grain legumes, especially groundnut—a novel system that is referred to as the doubled-up legume technology.

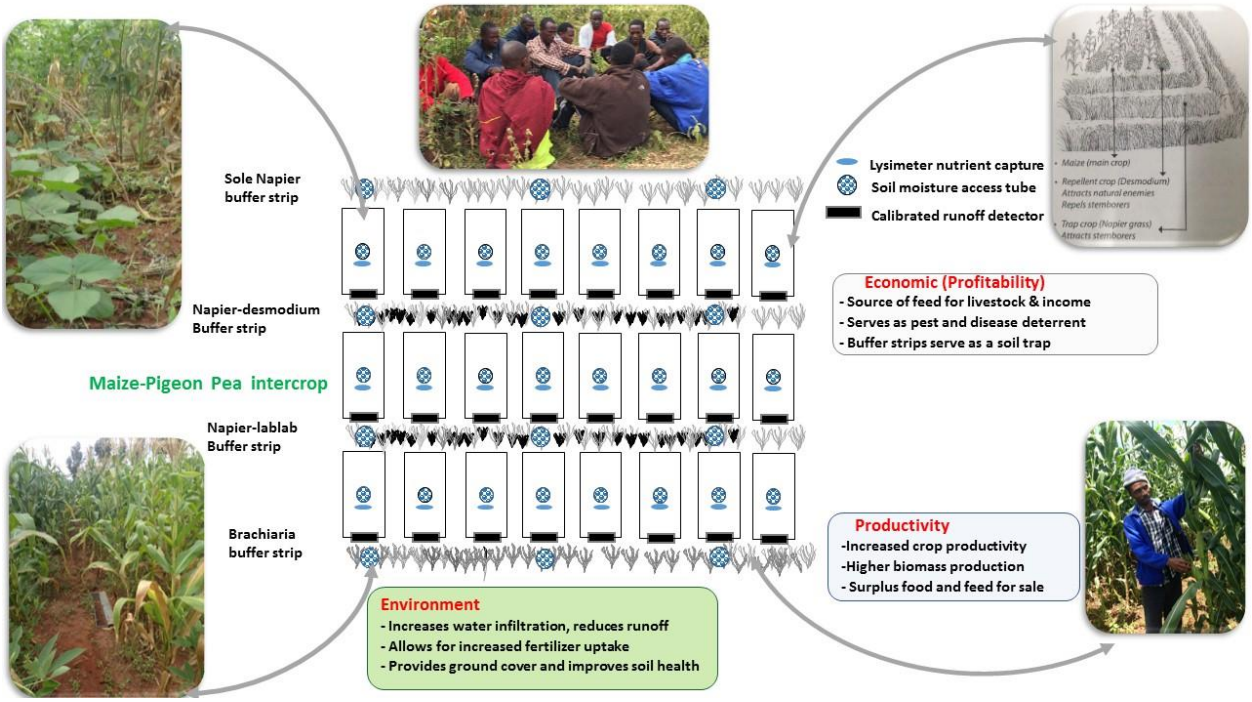
In the highly successful pigeonpea-groundnut doubled-up legume system, pigeonpea and groundnut are compatibly intercropped as they have different architecture and growth habits, ensuring minimal competition for light, water and nutrient resources between the component crops. The research team further explored 'best-bet: best-fit' pathways of intensification for contrasting farm categories (typologies). It examined how two sets of farm categories, resource-poor farms averaging 0.6 ha size and resource-endowed farms averaging 2 ha size, could benefit from the doubled-up legume technology. In both cases, the best-bet cropping options harnessed biological N2 fixation, ensured grain legume diversity for family nutrition and risk-buffered market opportunities, and concurrently added medium to high quality organic residues for enhanced soil fertility.

Tanzania: Systems research and the establishment of sustainable intensification

Sixty-five percent of the farms in Babati district, one of the two Africa RISING sites in Tanzania, suffer from nutrient mining. This is where the agricultural practices employed by farmers result in a negative nutrient balance, the loss of nutrients from the soil exceeds the gains from inputs, such as fertilizers. Not surprisingly, only 3% of farmers reported using (foliar) fertilizer, in large part due to a myth that fertilizers spoil soils. This myth was the consequence of a poorly-implemented fertilizer scaling exercise. Therefore, the Africa RISING scientists set out to address both the nutrient mining challenge and the myth by introducing flexibly-promoted technological packages, including allowing for partial or stepwise adoption as opportunities arose.

As a first step, researchers demonstrated that basic agronomy should be a starting point towards higher productivity. They demonstrated that following the principles of nutrient stewardship—applying soil nutrients of the right source, at the right rate, at the right time and in the right place—in the intercropping of improved (drought-resistant) maize, bean and pigeon pea varieties with the complimentary application of fertilizer would lead to high yields of the target crops (as in Figure 8, the maize–pigeon pea intercropping trial in Seloto).

Figure 8. Maize–pigeon pea intercropping trial in Seloto, Babati, Tanzania



The representation at the Seloto field offers a 'systems approach' that exemplifies sustainable intensification where crop productivity, profitability and the environment are all considered to ensure that smallholder farmers produce more food and feed for nutritional security and livelihoods without damaging the natural resource base upon which they rely.

For instance, cover and fodder crops (lablab, *Desmodium* and cowpea) known for high nitrogen fixation, and soil and water conservation, were introduced into specific niches, e.g. on terraces of sloping fields or as relay crops (between the lines of crops on fields). Adding these cover and fodder crops not only increased soil fertility, it also provided farmers with other services (acting as wind brakes to protect the main crop; increasing soil moisture capture from the maize–pigeonpea intercropping) and products (providing animal feed, household food, fuel, income from the sale of the crops, etc.).

When the cover crops were combined with Napier grass, they formed an integrated pest management system. The entire system served as a push-pull mechanism. The *Desmodium* acted as a repellent crop for stemborer—an insect larva that bores into plant stems—while the Napier grass acted as a trap crop for the same stemborer (see top right of Figure 8).

Soil moisture measurements help reinforce the research design by ensuring that soil moisture balance measurements inform what happens to nutrients within and beyond the crop-rooting zone for accurate recommendations of nutrient management regimens. The Africa RISING studies revealed that a combination of Minjungu Mazao, manure and nitrogen provides an economically viable option with minimal losses beyond the crop-rooting zone.

Seloto site represents a suite of interventions that serve as learning hub for five other villages in Babati (Sabillo, Long, Hallu, Quash and Ayamango). It offers smallholder farmers an opportunity to engage in learning alliances, and exchange information among themselves and with scientists, on what works in their particular circumstances. This serves as a scaling model with peer-to-peer learning for neighbouring communities. For instance, over the last two months, 587 farmers (302 in May 2016; 285 in June 2016) have visited and learned from the site.

Annex 4: Engagement framework

Type of stakeholder	Stage	Approach
1. Farmers	1. Selection and awareness raising of farmers	1. Select and raise awareness of farmers for the project 2. Undertake an inventory of existing groups (SWOT and relevance to project objectives) in consultation with multi-stakeholder platforms 3. Establish farmer groups if necessary and link with multi-stakeholder platforms 4. Strengthen the structure and governance of the groups 5. Develop a sampling protocol for farmer selection
	2. Diagnosis of constraints and opportunities	1. Capacity assessment 2. Participatory rural appraisal (Focus group discussion) 3. Household survey 4. Individual interview 5. Literature review 6. Rapid market assessment 7. Value chain analysis
	3. Identification and prioritization of research problems (entry points)	1. Focus group discussion 2. Farmer feedback sessions (community level) 3. Participatory modelling—scenario analysis to identify entry points 4. Present results from diagnostic studies to multi-stakeholder platforms
	4. Implementation (trials, institutional arrangement, collective action, etc.)	1. Develop and share research protocols with multi-stakeholder platforms 2. Develop capacity in identified area of needs 3. Participatory action research (joint design and implementation of on-farm farmer-managed trials) 4. Farmer field assessment (e.g. mother-baby) 5. Farmer field school 6. Technology park
	5. Feedback to farmers	1. Community and multi-stakeholder platforms validation of results 2. Participatory cost-benefit analysis 3. Farmer field day 4. Exchange visit and outreach program 5. Communication outputs e.g. leaflets, brochures, etc.
2. National agricultural	1. Raising awareness in extension service	1. Share briefs about the project 2. Inception workshop

extension service	2. Partnership-building and linkages	1. Develop capacity in partnership linkages and farmer mobilization 2. Participate and facilitate multi-stakeholder innovation platforms
	3. Implementation of research and feedback to farmers	1. Assess capacity needs 2. Design training to develop capacity, particularly in data collection and analysis, documentation, gender analysis, nutrition etc. 3. Review and planning meeting 4. Provide regular progress report to stakeholder innovation platforms 5. Writing and sharing reports 6. Participatory monitoring and evaluation
3. NARS (research institutes and universities)	1. Selection and awareness raising of farmers	1. Develop selection criteria 2. Participate in inception workshop 3. Share project documents
	2. Diagnosis	1. Assess capacity needs and develop relevant training packages and tools, (e.g. gender analysis, data collection and analysis etc.) 2. Develop and implement research protocols 3. Conduct data analysis and report writing
	3. Identification and prioritization of research problems (entry points)	1. Training in tools to identify and prioritize research interventions
	4. Implementation (trials, institutional arrangement, collective action, etc.)	1. Participate in multi-stakeholder innovation platforms 2. Assess capacity needs and develop relevant training packages and tools (e.g. gender analysis, data collection and analysis, etc.) 3. Develop and implement research protocols 4. Conduct data analysis and report writing 5. Facilitate better access to inputs e.g. improved seed, fertilizer, market etc. through multi-stakeholder innovation platforms 6. Provide information to farmers on good agricultural practices
	7. Feedback to farmers, development agencies, multi-stakeholder innovation platforms, policymakers etc.	1. Preparation and dissemination of research and policy briefs 2. Annual review and planning workshops 3. Country conferences on relevant project thematic
	1. Sharing of data and results	1. Comply with data sharing policy 2. Transparency in publication of research results by inviting those

		who have contributed to the research
4. Development agencies (NGOs) and other complementary projects	1. Project inception	1. Map development practitioners (who and what) 2. Share project materials 3. Participate in inception workshop
	2. Identification and prioritization of research interventions	1. Training in tools to identify and prioritize research interventions
	3. Research implementation (trials, institutional arrangement, collective action, value chain development, nutrition and gender, etc.)	1. Participate and facilitate in multi-stakeholder innovation platforms 2. Assess capacity needs 3. Design training to develop capacity, particularly in data collection, analysis and documentation, gender analysis 4. Participate in project review and planning meeting 5. Participatory monitoring and evaluation
	4. Scaling out of innovations	1. Leverage on their partnerships and linkages to scale out innovations 2. Package the innovations for different targets 3. Farmer mobilization and organization
5. Private sector	1. Supporting research interventions (e.g. inputs and services, machinery, credit, market, etc.)	1. Develop gender-responsive business and delivery models to support innovations 2. Engage in multi-stakeholder innovation platforms for better access to inputs (seed, fertilizer etc.), information and other linkages
	2. Commercialization of innovations	1. Package the innovations for different targets 2. Develop business and delivery of inclusive models to support commercialization
6. Policymakers, including central and local governments	1. Project inception	1. Participate in project review and planning meetings
	2. Dissemination of project outputs and outcomes	1. Share policy briefs on project outputs 2. Engage in policy dialogue and advocacy on emerging outputs from the project 3. Engage in multi-stakeholder innovation platforms
	3. Scaling out and commercialization of innovations	1. Lobby for policy support to promote implementation, adoption and commercialization
7. Potential donors	1. Project inception	1. Share project materials 2. Participate in inception workshop
	2. Feedback to donors	1. Share project results

		2. Organize annual review and planning workshops
	3. Supporting scaling out and commercialization of innovation	1. Lobby for financial support to promote implementation, adoption and commercialization
8. Peers	1. Diagnosis	1. Share tools and research protocols 2. Organize joint planning and implementation sessions where necessary
	2. Identification and prioritization of research problems (entry points)	1. Share and review protocols 2. Build capacity of peers
	3. Implementation (trials, institutional arrangement, collective action, etc.)	1. Harmonize time plan for implementation of activities 2. Develop common procedures for the project team for implementation of activities
	4. Sharing of data and results	2. Comply with data sharing policy 3. Transparency in publication of research results by inviting those who have contributed to the research

Annex 5: Engagement standards

Africa RISING is a research for development program that aims at providing pathways out of poverty for smallholder farmer households through sustainably intensified farming systems that improve food, nutrition, income security, particularly for women and children, and conserve or enhance the natural resource base. Participatory research is a key foundation to achieve these goals and emphasizes the importance of engaging relevant stakeholders in all steps of the research process. Participatory research approaches therefore demand a level of engagement and commitment from farmers that researchers need to respect. Equally, researchers need to engage with each other for mutual learning, integration of research activities and to ensure that farmers and other stakeholders are not overburdened by research activities. In order to avoid redundancies and add value, the program will leverage other opportunities with different stakeholders and complimentary projects.

This document provides some guidelines to researchers that will help proper engagement with stakeholders across the development value chain and to avoid negative relationships between them, farmers and other stakeholders and foster ethical conduct within the Africa RISING community. It is also necessary for researchers to obtain clearance from the 'ethics review committee' or similar applicable in respective organizations and/or national agencies in the country of operation for studies dealing with human subjects. Guidelines provided here are not exclusive to those provided in the policy documents of respective organizations/countries.

Farmer engagement in research processes

Diagnostic studies
Gaining an understanding of the farming and wider livelihood systems targeted by research projects is an essential step in targeting research activities that will lead to impact and measurable development outcomes. As the first point of engagement between projects and communities, proper conduct of such studies can help to establish lasting trust and partnerships between all actors in the research process. The guidelines are as follows:

- Diagnostic studies are generally highly extractive in nature with farmers gaining little direct benefit from them. They could however raise farmers' expectations of future exchanges that operate on a two-way basis. It is not advisable to conduct diagnostic studies without clear follow-up activities. It is imperative that researchers avoid causing community members to have unrealistic expectations. This includes pointing out the limited period of the engagement. At the start of the research process, participants should be given an opportunity to clarify their expectations. Farmers should be made aware that the researchers also rely on what farmers have agreed to contribute and that it is therefore important that farmers make firm commitments.
- Having said this, well-conducted diagnostic studies generally stimulate dialogue with participating farmers and catalyse buy in from them. Responses to queries from farmers like "Sorry we don't have time, the next question is…." are not acceptable. It is therefore advisable that researchers should build time into the interview schedules that allow for satisfactory responses to any questions/ discussions that farmers might initiate.
- Before starting a diagnostic survey, farmers' consent to use their data confidentially must be obtained.

- Farmers often give up a considerable portion of their busy days to participate in diagnostic activities. Respect this by conducting interview schedules on time and organizing things, as far as possible so interviewees are not waiting around.
- When planning field activities of any type, but particularly for diagnostic interviews, familiarize yourself with the farming calendar. To the extent possible, conducting socio-economic surveys during peak periods in the farming year (planting, weeding, harvesting etc.) should be avoided. Having a proper understanding of the gendered division of work and responsibilities would provide a clear understanding of the periods when women and men are available to participate actively in diagnostic activities.
- After completion of a diagnostic study researchers should provide feedback to the communities about their findings. These feedback sessions also allow for validation of the study results. To improve planning, these feedback meetings to the communities should be a standard item also reflected in the researcher work plan.

Identifying research problems

It is imperative that the farming community is actively engaged in selection and prioritization of research topics. This fosters inclusiveness and integration of community perspectives in research thereby implementing research that is more responsive to farmer needs. During this process:

- Researchers and community members need to come to a mutual agreement when establishing research topics, approaches and identifying viable interventions. Researchers and community members determine what works and what does not work, or what is within the project limits and donor interest.
- Researchers and farmers should be realistic about what their research can accomplish to build trust among researchers and community members.
- Gender roles influence the perceptions of men and women on research problems. Therefore, gender has to be considered as a significant component in identifying research problems. Compare the similarities and differences between men's and women's experiences and perspectives and value them equally. This will generate a more comprehensive picture of the problem, and facilitate design of tools, which will better address gender differences.
- Power relations between men and women influence their perspectives about their problems and proposed solutions. It is imperative that researchers take into account the roles of men and women and other prevailing cultural norms and how these may impact on the outcomes of the research.
- Researchers need to listen to the voices of community members and share power in making research decisions. There is need to be sensitive to gender and cultural issues within a community.

Selection of research beneficiaries or participants

Researchers need to be flexible in determining who represents the community so as not to miss out on what is important for the community. Criteria for selection could include among others: willingness to host the experiment, willingness to share and teach other farmers, openness to visitors, ability to follow the protocols, visibility and accessibility of plots, reliability of experiment management.

- Involve community leaders in planning, implementation, monitoring and evaluation to further create a sense of ownership and acceptability of the research.
- It is important that researchers understand that farmer participation is voluntary. Levels of participation may differ according to interest, resource availability and cultural context. Some people will be highly motivated to participate while others may not.

- Pay special attention to the category of people who tend to face discrimination in research for development programs. These could be women, young people and the landless, among others. A thorough context analysis should provide for the development of specific strategies to include them.
- Be aware of the fact that the interests of researchers and community members influence their perceptions on who to work with and how, where and when.

Conducting research

In order to ensure continuity from diagnostics to results and later on to adoption, farmers who were engaged in the earlier stages of the process should be included in the research implementation. This adds to building ownership and trust between researchers and farmers.

- Prior to beginning a study, researchers must disclose to all participants the overall objectives of the project and its sponsor. Transparency allows farmers to make informed decisions as whether to engage in the project or not. Researchers have to be clear about the voluntary nature of participation and seek consent in an open manner. Farmers may reject or withdraw their consent at any time in the course of the research.
- Constraints and risks associated with technologies should be made known in advance and mitigating measures should be put in place.
- When researchers and farmers agree to work together, the group has to decide on the modalities of working together. This includes setting goals and objectives, selecting methodology, agreeing on methods of communication, sharing roles and responsibilities and agreeing on the processes of data collection, monitoring and evaluation. This might require the training of farmers in data collection.
- Select gender sensitive tools, methodologies and approaches, which will encourage and enhance active participation of men, women and youth, and conserve integrity.
- Collect and generate data that is meaningful to the community to create a sense of ownership and sustain participation. It is important that the research seeks information that will be useful to the community and also influence policy.
- Assess the impact of the proposed solutions on men and women in terms of their capacity to access resources, workload, social status, and power relations.
- Some of the meeting venues and times may not be convenient for men, women and youth to engage actively. Therefore, researchers should have a clear understanding of the effect of a venue and time on participation of men, women and youth to avoid exclusion.
- Conflict of interest between researchers and community members, or amongst researchers or among different groups within a community will be encountered at different stages of the research process. Community members and researchers need to come to an agreement on different aspects of the research at the onset to minimize conflict.
- Regular feedback sessions should be scheduled to inform farmers about experiments and the use of their data. Equally important are these feedback sessions for researchers to get the views of the farmers to adapt the experiments or data collection tools.

Completing engagement with farmers

Researchers must ensure a smooth conclusion of the engagement by involving the key stakeholders, who were involved in previous stages of the research. Conclusion may happen gradually or suddenly depending on various factors (local, external).

- Should project activities be phased out, farmers should be informed in due time about the reasons and the completion process should be agreed upon. Farmers should be

informed about the researchers' next steps to ensure farmers will benefit from their past engagement.
- Researchers need to reflect upon potential negative effects associated with the end of the engagement and consider compensation if necessary (preferably in kind).

Researcher engagement with peers

SI needs coherence and integration of research results. Therefore, researchers need to work with each other to leverage opportunities and resources. For this to happen, researchers need to treat each other with respect and be cognizant of the fact that peers often come from different institutions. The following guidelines for working with peers are suggested:

- Avoid redundant surveys through coordination with other researchers and making use of each other's data. This will reduce farmer research fatigue and support our objective of systems research.
- All research results have to be validated by stakeholders and farmers.
- Training in participatory methodology and its application is a requirement for all researchers.

Researcher engagement with other stakeholders

Apart from engagement with farmers and peers, researchers build partnerships with extension agents, other development agencies and complementary projects, private sector, policymakers, national agricultural extension and national research institutes. Engaging especially with national institutions aims at achieving the sustainability of the program through institutional capacity building.

Sub-contractors should follow the engagement standards with farmers and peers. When working with other stakeholders, researchers should ensure that stakeholders are aware of these standards.

Risks of working with Africa RISING, e.g. finite duration of the program, need to comply with reporting requirements, financial standards, etc. need to be explained to sub-contractors.

Partnerships should be monitored and performance be reported back regularly to stakeholders.

When disengagement with other stakeholders is required for whatever reason, researchers must ensure a smooth conclusion of the engagement. As with farmers, conclusion may happen gradually or suddenly depending on various factors (local, external).

- Should project activities be phased out, stakeholders should be informed in due time about the reasons and the completion process should be agreed upon.
- Researchers need to reflect upon potential negative effects associated with the end of the engagement and keep these as low as possible.

Data handling

Ownership and custodianship of data collected by the Africa RISING program are a sensitive issue. Each participating CGIAR centre is responsible for providing assistance with publishing the data sets in line with open access policy. Open access means that the source of the data and some overall information about the datasets are freely accessible, but not the detailed research data. A contact person should be stated in case somebody would like to access those data.

The general principle underlying this program's activities is that all data are under the shared ownership of all program partners.

- Each research team will appoint one person responsible for uploading and monitoring FTF (and custom) indictors on the Project Mapping and Monitoring Tool (PMMT).
- Custodianship will be determined by the capacity of the responsible organization and staff to hold and distribute data securely and according to the rules set by CGIAR Data Access Policy.
- To ensure custodianship all meta- and unit-record data have to be uploaded on the Comprehensive and Knowledge Archive Network (CKAN) following the Africa RISING data management policy (IFPRI 2014). According to this policy, the data provider and custodian might keep unit-record data for his/her exclusive use for a limited period of time (depending on the data type) only for publishing purposes. For necessity and urgency of program needs, this period could be lifted if unit–record data are necessary for a better management and higher impact of the program's interventions. Thereafter, unit-record data will have to be made available to other colleagues (within and outside the program) upon request.
- Access to sensitive social science data should be particularly restricted, meaning the datasets need to be published for reference but not for full access. They will not be made accessible at any time. Where applicable, access to sensitive data (e.g. personal data) should be guided by the ethical policy approved for a particular study.
- Publication rights are shared amongst all partners but original data collection and provider teams should be acknowledged in all cases. Authorship is granted to all partners who participate in the design, implementation, analysis and findings of studies that make use of project data, but is not required for data collectors and providers.
- Researchers who intend to publish research results should invite all colleagues who participated in at least one stage of the research process (design, implementation, analysis) to contribute to the publication.
- Any publication for the Africa RISING and CGIAR repositories has to follow the Africa RISING branding guidelines that are in line with the donor branding policy.
- Researchers should maintain that the ultimate owners of the data collected are the farmers. Therefore, it is strongly encouraged to exert any efforts to engage communities and their members when reporting back the research findings to increase ownership of research findings.
- Consideration of gender perspectives in data analysis, interpretation and dissemination will enhance design of appropriate interventions.
- Maintain anonymity and confidentiality of farmers participating in the research. Researchers need to adhere to standard anonymization protocols in handling identifying information, keeping it separate and in a safe place, and providing the utmost confidentiality of farmer data. Researcher should adhere to ethical policy guidelines where applicable.
- Ethical clearance must be obtained from relevant authorities for any data collection activities that involve human subjects.
- Taking and publishing pictures or any information that allow tracing back to individuals should be done only upon their consent and in accordance with the donor, institutional and Africa RISING data management policies.

Incentive mechanisms

The issue of offering project participants incentives to join activities requires sensitive handling, particularly in relation to the options that are open to other agencies operating in the same area that may not be able to 'compete'.

Africa RISING has been using different incentive mechanisms to make sure that long-term community benefits will not be at stake because of insensitivity to short-term expectations. The main incentive for farmers is to participate in the action research (research trials) and community-based activities, such as seed multiplication, that include technological and technical inputs for the SI activities on crop, livestock, tree and natural resource management activities. Non-participating farmers also do have access to farmer-to-farmer technology transfer through their participation in field demonstrations or trial evaluation events, such as farmer field days and participatory variety selection. Other incentives can be in the form of cash or in kind. In the trials hosted by farmers, they receive inputs (fertilizers, seeds, tree seedlings, small livestock) and are allowed keep the produce of these harvests. For the time they spend with survey teams they are usually given a small token such as a soap bar or a bag of salt.

The program has guidelines concerning payments to farmers and other local partners during participation in various events, including field days, experience sharing visits, trainings, workshops and survey activities. Often, these events are organized in places where participants face costs for transportation and meals. In such cases, Africa RISING provides judicious compensation in cash. When there is no expenditure, no money will be paid (see below).

Experience sharing events, trainings, participatory research approaches and gender sensitivity are other forms of incentives that help Africa RISING in making farmers see the benefits of our research interventions.

Conclusions
Participatory research requires active involvement of farmers and other stakeholders in the different stages of the research processes. The required level of engagement may not be achieved without respect of stakeholders as equal partners and recognition of their key role and input. Participatory research also requires proper understanding of the cultural, social, economic and political factors and how they influence participation, buy-in and compliance. Gender, ethnicity, religion as well as other socio-demographic and cultural/social norms in access to resources, division of labour and institutional factors need to be considered throughout the process.

Specific training might be necessary to ensure that participatory and gender sensitive approaches are followed by Africa RISING researchers and partners. The program will conduct a needs assessment and provide the necessary resources to train the researchers and partners.

These guidelines will be reviewed and adjusted in line with evolving CGIAR guidelines around engagement, ethics, and data management.

Input provision arrangements

The guiding principle of the Africa RISING program has been that free inputs are only provided to participating farmers at the stage of validation-adaptation-adoption of a technology, more specifically during early stages where performance of those inputs is not guaranteed and where risk for participating smallholder farmers needs to be minimized. At later stages, once the performance of inputs has been validated, inputs will no longer be given for free.

In line with the R in D approach of the program, Africa RISING will monitor the adoption of proven technologies made available by development partners to farming communities. However, the input provision arrangements in the program vary from project to project, according to the particular circumstances in the countries and sites involved, and are therefore described separately.

Ethiopia

In phase II (as in phase I) of the project, farmers in the Africa RISING Ethiopia project will participate in the on-farm action research activities under a variety of arrangements. The principal activities are: technology demonstrations, community-based seed multiplication, and technology scaling.

Technology demonstration: Farmers will contribute land/space, wood and labour, whereas Africa RISING Ethiopia provide inputs (fertilizer, improved seed, pesticides, etc.). This arrangement helps farmers identify/validate technologies useful to their needs, as well as building confidence in local workability and suitability of the technologies. The researchers will collect data on the performance of the technologies, compare these with local technologies for various attributes, document farmer criteria for the evaluation of the technologies, and identify which technology suits which households.

Community-based seed multiplication: In return for agreeing to plant selected varieties on large plots of land, the project will provide the farmers with the starter seed of their choice, their preferred improved varieties, as part of a seed revolving scheme, i.e. the seed provided is returned at harvest time and distributed to other farmers. In this scenario, the farmers are responsible for procuring most inputs, such as fertilizer, pesticides, labour and land, while the project promotes good agricultural practices on spraying, planting, seeding, etc. The researchers will capture yield data, and collect seed distribution information from producers to determine many farmers benefited from quality planting material and how the technology in question has been disseminated. The project will also encourage community seed producers to form cooperatives and link them with the producers, enhancing demand for quality planting material.

Technology scaling out: Farmers will be responsible for all inputs in technologies scaling out activities. In this case, the project will facilitate and support the capacity development (training and visits) aspects and link the farmers to input suppliers, market dealers and service providers. Kebele- and district-level extension services help farmers gain access to credit for the purchase of inputs, and in addition local partners purchase improved seed and provide it to farmers on the basis of seed revolving arrangements.

West Africa

More than 90% of the Africa RISING West Africa research-in-development activities on crop, livestock, crop–livestock and soil/water/land management will be implemented on farm in phase II (as in phase I) of the project. These activities are implemented with a variety of partners—including men and women farmers, farmer and women's interest groups, and young people. The activities are managed by: researchers; partner groups; and researchers and partners.

Africa RISING West Africa will provide research inputs for farmers involved in technology development and validation trials designed to ensure a greater level of scientific rigour in the analysis of bigger technologies/practices and treatments—referred to as 'mother trials' managed by researchers, and researchers and partners. This includes on-farm and on-

station applied and adaptive research on: crops (varieties, cropping systems); livestock (feeding, health, breed and breeding, housing, manure); soil/land and water (fertilizer, irrigation, water harvesting, small-scale irrigation, agro-forestry); food safety; value-addition; and post-harvest losses.

Research inputs will also be given to partners involved in building research capacity for development activities. The inputs will include small-scale tools and machinery to generate and demonstrate technologies/practices at farm and community levels (e.g. seeders, shellers, feed choppers, milk processing machines, etc.) and to generate data for graduate dissertation research (e.g. feed analysers, soil moisture monitors, etc.).

For farmer-led trials—referred to as baby trials—designed to provide supplementary information on the adaptability of the technology/practice to the ecological and farmer management environments, only inputs not available locally are provided to the farmers.

East and Southern Africa
In phase II (as in phase I) of the project, Africa RISING East and Southern Africa will provide research inputs for two main purposes: research and technology demonstration for scaling.

Research inputs will be provided in a research setting where trials are installed to generate data and information for the development and/or validation of technologies. In this case, the research inputs are either (i) integral to the research process, e.g. seed for new varieties, fertilizers, manures, post-harvest kits, or (ii) provided for the purposes of building capacity for research on and development of related technologies, e.g. feed processors, lab equipment, automated weather stations. Where the inputs in the latter category are non-perishable, they are left behind at end of project and essentially given away for free to the relevant institutions.

Free inputs are given to lead farmers for the purposes of facilitating the raising of awareness of specific technologies among communities with a view to triggering their adoption. Farmers are randomly selected using a public lottery approach. Those who are selected receive a coupon for inputs (fertilizer, seeds) or a particular technology on a once-off basis at the beginning of the planting season. The approach is employed so as to allow the farmers to test the technology/ approach and later be able to determine their willingness to pay for it in the future. Free inputs have been provided to leading farmers in setting up demonstrations as part of the technology delivery and scaling initiative of the Africa RISING—NAFAKA project.

The main difference is, therefore, that research inputs relate to a **trial** setting and free inputs relate to a technology **demonstration** setting.

Guidelines on payments to partners

There is a need to reward partners for the efforts that they make on behalf of the project. However, it is essential that these payments (including in-kind contributions) are made in a way that is equitable across all partners and does not compromise the activities of other organizations by inflating remunerations. The Africa RISING situation is complex as the project involves a relatively large number of CGIAR organizations (as well as local partners) which all have their own particular rules and guidelines on such payments. This annex defines some standard criteria for Africa RISING collaborators.

The following categories of partners are eligible for payments:

Farmers: Farmers participating in Africa RISING should receive some form of compensation for the time and effort they dedicate to the project. Direct cash payments to farmers are not generally recommended as they can distort expectations and lead to friction amongst recipients and non-recipients. An exception to this might be where a farmer has resorted to public transport to attend a meeting or function related to Africa RISING. Any form of farmer contact should, generally, respect their status as equitable partners in the project; the nature and extent of any in-kind contributions should reflect this.

Extension officers: Depending on capacity and motivation levels, participation by extension officers are likely to vary across sites. Where they participate actively in Africa RISING research activities, this should be recognized by some form of top-up payment. To some extent, this will have to be determined on an *ad hoc* basis with an agreed number of days being paid at a standard daily rate.

District and zonal officials: District and zonal officials may participate actively in project activities; in which case they should be appropriately remunerated at the same level as participating researchers (see below). Sometimes, officials may request a 'facilitation' payment for assigning their staff to Africa RISING activities, without actually participating in Africa RISING activities themselves. This should be strongly discouraged. Site coordinators need to explain that such payments are not allowed under the Africa RISING project and would be unacceptable to our project auditors. Should these requests persist, site coordinators should refer them to the Africa RISING management.

Researchers (national university/research centre): All researchers participating in the project should be treated equally in terms of the remuneration that they receive. Site coordinators and other project staff will need to determine appropriate levels of participation needed and by whom in order to discourage a development tourism industry approach around the project.