Africa Research in Sustainable Intensification for the Next Generation

Monitoring and evaluation scope of work for Phase II (2016-2021)

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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 U.S. government's Feed the Future 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 regional projects are led by the International Institute of Tropical Agriculture (in West Africa and East and Southern Africa) and the International Livestock Research Institute (in the Ethiopian Highlands). The International Food Policy Research Institute leads the program's monitoring, evaluation and impact assessment. http://africa-rising.net/

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Contents

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Introduction

Africa RISING (AR) is a research for development program designed to pilot potential interventions for the sustainable intensification of mixed crop-tree-livestock systems and provide data to help improve designing of similar research as well as development projects. It comprises three linked projects in West Africa and East & Southern Africa (led by IITA) and Ethiopian Highlands (led by ILRI) with a monitoring and evaluation (M&E) and communication components led by IFPRI and ILRI, respectively. Phase II of Africa RISING seeks to build on the strengths and successes of the individual projects and the learned lessons. The core approach will be to broaden engagement with development partners which, backstopped by target Africa RISING research, will have the capacity to generate impact at scale through the deployment of Africa RISING innovations. The program character of Phase II will be further enhanced to ensure that opportunities for cross-scaling and wider dissemination of research outputs are not lost.

AR researchers are testing baskets of SI interventions in selected communities across the six program countries (Ghana, Mali, Ethiopia, Tanzania, Malawi, and Zambia) and eventually identifying promising innovations suitable for the local agro-ecological and socio-economic conditions.[1] As discussed in detail in the IFPRI's annual M&E reports[2], the evaluation design adopted by IFPRI (discussed in Section 3) will provide evidence on the characteristics of the farm households and villages on which SI innovations are being tested. Furthermore, endline data collected during Phase II will support attribution of agro-economic effects to participation in AR. The comparison with the broader population of farm households within similar agro-ecological zones could provide a good indication of the expected *overall* impact of these innovations. When the number of farm households adopting a given (mix of) innovation is high enough, regression analysis can be used to estimate the innovations' agro-economic effects. While data from IFPRI's baseline surveys are used to characterize and assess the predicted effects of AR innovations on immediate outputs (such as yield and crop income), baseline data will be combined with follow-up surveys to generate more robust evidence on the effects of these innovations, including on long term outcomes (e.g., nutrition and poverty).

This scope of work outlines the main monitoring and evaluation-related activities IFPRI proposes to undertake in Phase II (2016-2021). Detailing these activities is deemed crucial to promote efficient collaboration between IFPRI and AR researchers, maximizing the alignment of the expectations for the overall benefit of the Programme.

The rest of this document discusses main monitoring-related tasks accomplished during the period 2011-15 and proposals for Phase II (Section 2); main evaluation-related tasks accomplished during the period 2011-15 and proposals for Phase II (Section 3); and concluding remarks (Section 4).

[1] The definition of community varies across countries depending on the local administrative and geographical arrangements. In this document, community and site are used interchangeably.

[2] Available at http://africa-rising.wikispaces.com/program_moneval

Monitoring within Africa RISING

Main monitoring-related activities accomplished 2011-2015

A summary of the main monitoring-related tasks undertaken by IFPRI (with support of AR research teams) during the period 2011-2015 is summarized in Table 1.

Table 1. Main monitoring-related activities undertaken 2011-2015

Activity	Remark
Site visits	Continuous as needed
Annual M&E expert meeting	Held locally in AR countries on a rotating basis
Development of the Project Mapping and Monitoring Tool (PMMT), including associated user guide and video tutorial	The PMMT is an open-access web-based platform developed in collaboration with an external contractor
Reporting of FtF Indicators data	FtF indicators data were compiled and aggregated to mega-site level through the PMMT
PMMT trainings	Two rounds of five in-country trainings were conducted in 2014 and 2015 in Malawi, Tanzania, Zambia, Ghana, and Ethiopia. In each round, more than 50 researchers have been trained on the PMMT
Collection of ARBES (Africa RISING Baseline Evaluation Surveys) socioeconomic data	ARBES data have been collected from all program countries (except Zambia) during 2013-2014. Data from these surveys have all been cleaned and are publicly available for analysis by AR researchers and the general public here: Tanzania: http://dx.doi.org/10.7910/DVN/PPUL2W Malawi: http://dx.doi.org/10.7910/DVN/28557 Ghana: http://dx.doi.org/10.7910/DVN/QUB9UT Mali: http://dx.doi.org/10.7910/DVN/UDKSBJ Ethiopia: http://dx.doi.org/10.7910/DVN/H6RWOO
Production and distribution of ARBES survey reports	ARBES summary reports have been produced and shared with AR researchers. Reports can be downloaded following the links here (Malawi), here (Tanzania), here (Mali), and here (Ghana)
Data management plan	Approved in November 2014
AR data management through ILRI's CKAN	Continuous, in progress (in collaboration with ILRI)
Production of number of potential beneficiary households to inform the vision of success	Working with AR researchers, initial data were compiled on the current number of direct beneficiaries, as well as on the projected potential direct or indirect beneficiaries (through partnerships)

Proposed monitoring activities to be undertaken by IFPRI in Phase II

Below are the list of monitoring-related activities IFPRI is proposing to undertake in the coming years.

a. Maintenance of the PMMT: IFPRI expects to continue monitoring AR activities through the web-based PMMT. Input to feed into the PMMT (including data on FtF indicators) is expected to be provided by AR researchers on the field. It is worth remembering that PMMT allows not only monitoring FtF indicators, but also custom indicators in which individual projects and teams might be interested.

To assist with proper compilation of indicators data offline, IFPRI has produced (and shared with AR colleagues) an Excel-based spreadsheet as FtF indicators template with internal consistency checks and mandatory fields for discrepancy narratives to assist AR researchers with accurate aggregation of FtF indicators data offline (for later uploading onto the PMMT upon access to internet). AR field staff responsible for collecting and submitting FtF indicators have been trained in both the online and offline FtF indicators data entry. As part of the round of updates to the PMMT, IFPRI with the IT contractor has separated the PMMT mapping application from the data entry application (which has significantly improved the speed of the latter).

b. Timely reporting of FtF and custom indicators data: in the PMMT aggregation of work-package level data into mega-site level necessitates accurate and timely data input (both aggregated and disaggregated) from AR researchers, along with relevant narratives when deviations between target and actual performance are over 10%. Considering the time necessary for uploading FtF indicators data onto the FtFMS (Feed the Future Monitoring System), IFPRI proposed that all AR researchers upload complete FtF indicators data and narratives onto the PMMT by **October 15th** or a month before the FtFMS portal closes, whichever comes first.[3] This will allow IFPRI to communicate with AR researchers about any missing information, aggregate work-package level entries up to mega-site level, and upload aggregated FtF data onto the FtFMS on time. Given that the FtFMS portal stays open for a fixed number of days, it is crucial that the offline FtF indicators data template gets accurately completed and data thereof get uploaded onto the PMMT in a timely manner to ensure timely indicators submission onto the USAID-FtFMS portal by IFPRI.

c. In-person project monitoring: IFPRI has program-level responsibility for M&E. Nevertheless, monitoring responsibilities are shared between the regional projects and the IFPRI M&E team, while evaluation tasks are the sole responsibilities of the M&E team.

The entire M&E team will continue interacting with AR researchers (virtually and in-person) to provide monitoring-related guidance, as needed. The type of guidance will be determined by the topics and issues arising. For example, the IFPRI M&E team will be supporting a team in developing a proposal that involves specific socioeconomic indicators to collect or

[3] In 2014, for example, the FTFMS opened on October 1, 2014 and FTFMS submission deadline was on November 18, 2014.

research design to adopt. The in-person project monitoring will be conducted and facilitated by the four M&E data managers/research assistants based locally.

d. PMMT (refresher) trainings: To enhance project monitoring through the PMMT and building upon feedback received during the first wave of PMMT trainings, the M&E team will provide additional PMMT trainings to AR researchers. While a total of 60 AR researchers have attended the first wave of trainings, the M&E team is proposing the following plan for the upcoming trainings.

a. PMMT trainings be given to selected AR researchers who are expected (by their mega-site and country leads) to assist with monitoring their respective projects and teams.
b. To achieve (a) and working with AR researchers, IFPRI already identified regional and country representatives who will attend these trainings and also act as points of contacts (POCs).

The location and timing of these trainings will be decided in consultation with AR partners.

e. Cataloguing of AR innovations: Given the diversity in AR innovations being tested, systematic cataloguing and synthesis of the innovations will help with better understanding of the diversity of current AR innovations and assist with the designing/selection of next wave of innovations. Program-wide cataloguing could be crucial to accurately interpret research outputs, and to have a better idea about promising technologies. The four local M&E data managers/research assistants, in collaboration with the DC-based M&E staff and AR researchers will compile the relevant information about AR innovations through in-country discussions and interactions with AR researchers.[4]

f. Beneficiary tracking system (BTS) set-up: the M&E team will set-up the template and share it with the research teams. The BTS will encompass tracking the activities conducted by the research teams at the household level, allowing data collected at different times by different actors to be matched and, eventually, interoperable. For this important activity, in addition to the other monitoring and evaluation tasks, the local M&E data managers/research assistants will be essential. IFPRI is planning to set up a unique ID attribution system across all research themes. The ID assigned to each farmer will be linked to the data of all AR activities, including surveys, and input delivery in which s/he took part.

g. Socio-economic, agronomic/biophysical, and SI indicators data repository supervision (CKAN): data will be collected at various points during project implementation. 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 thereof. In addition, observational data will be collected on local farming systems and farm households reliant on them. As in Phase I, socio-economic household and community survey data will be collected by the IFPRI M&E team on

[4] Previous attempts to collect details about AR innovations through the PMMT have not received much response, so other solutions might be sought.

farm households in intervention as well as randomly selected communities. In Phase I AR has been collaborating with the Sustainable Intensification Innovation Laboratory (SIIL) to develop a framework for assessing SI. Teams from Michigan State and Cornell universities (MSU and CU) are currently developing the framework. All the different datasets will be uploaded and properly documented into the CKAN platform. In addition, IFPRI will monitor the 12-month embargo period, to be able to notify each researcher when the deadline for data upload and sharing is approaching. Accurate monitoring of the embargo period requires the active participation of all AR researchers to inform the M&E team, the donor, and all other AR stakeholders of various data collection activities.

Monitoring activities to be undertaken by ILRI and IITA in Phase II

Day-to-day project monitoring: IFPRI had discussed with IITA and ILRI the need to have local project monitoring coordinator and data manager to be based in Mali, Ethiopia, and Ghana. The local coordinators/data managers will provide all the necessary backstopping activities to AR researchers and IFPRI's M&E team, as it relates to the monitoring of AR activities and overall management of data thereof (as discussed in Section 3). In East and Southern Africa (ESA), tasks and responsibilities will be taken up by the M&E local coordinator, based in Arusha (Tanzania), with joint supervision with the ESA Chief Scientist.

AR data management through CKAN: Given the consensus to use ILRI's open-source data portal platform (CKAN, accessible at http://ckan.org/) as a repository for AR-generated data, IFPRI has been working with ILRI[5] to allow uploading of the meta-data (to be) received from AR researchers and, subsequently, of the associated raw data files. A summary of AR meta-data received by IFPRI as of April 21, 2016 is shown in Appendix A.

However, due to the multiple layers of communication among ILRI, IFPRI, and the AR researchers, the data sharing process has been moving slower than expected. Therefore, for Phase II of the program, IFPRI proposes that ILRI's CKAN team take the lead in the management of AR data through CKAN. The ideal arrangement would include a reconfiguration of CKAN, which would allow researchers the ability to manage their own datasets and access to them. Another option could be to assign the AR CKAN maintenance task to the Ethiopia-based M&E data manager (also responsible for monitoring AR activities in the Ethiopian Highlands mega-site, as discussed below). Discussion on this specific aspect is still ongoing.

Proposed IFPRI M&E staffing arrangements in Phase II

The core IFPRI M&E team will be based in Washington, DC. It will encompass the team leader, the global M&E Coordinator, and two Senior Research Assistants (all part-time positions). The team will be supported locally by four data managers/research assistants.

For East and Southern Africa (ESA), the Arusha-based M&E specialist will assist the research teams with monitoring tasks, ranging from indicator data collection to be uploaded onto the PMMT to

[5] The ILRI data portal for AR (http://data.ilri.org/portal/group/africarising) is mainly managed by Carlos Quiros' team at ILRI.

beneficiary data collection to be submitted to the M&E team, and monitoring project-generated data sharing and upload onto CKAN. He/she will continue to report to the M&E team, although he will be fully embedded into the ESA local team with joint supervision by the ESA Chief Scientist.

For West Africa (WA), two data managers/research assistants will be locally-hired in Ghana and Mali to assist with monitoring tasks, ranging from indicator data collection to be uploaded onto the PMMT to beneficiary data collection to be submitted to the M&E team, and monitoring project-generated data sharing and upload onto CKAN. The M&E team and the lead agency (IITA) will jointly cover the positions of the two data managers (with the approximate proportions of 75% and 25%). Also, joint supervision roles are envisioned between the WA Chief Scientist and the M&E team.

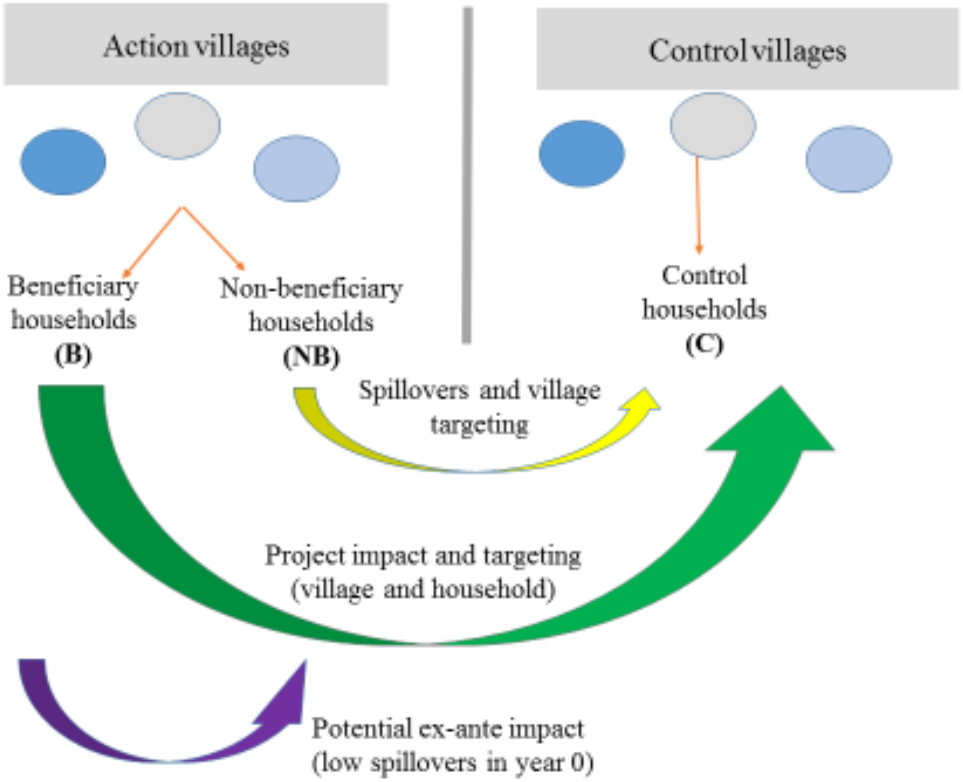
For the Ethiopian Highlands, one data manager/research assistant will be locally-hired by ILRI and based in Addis Ababa, with frequent travels to the project sites. The M&E team will cover this position, and joint supervision roles are envisioned between the Ethiopian Highlands Chief Scientist and the M&E team.

Evaluation within Africa RISING

To help identify promising innovations as well as test the hypothesis that AR interventions lead to improved whole farm productivity and development outcomes, one would need to answer the counterfactual question of "how would farm productivity and development outcomes have fared for farmers who are offered (and adopted) the innovations in the absence of the innovations?". Since it is impossible to know the answer to this question, one needs to identify households with similar characteristics (on productivity potential, welfare, etc.) as those of AR beneficiaries but not targeted by the program(counterfactual group). Given the non-random selection of AR beneficiary households, the counterfactual group needs to be constructed with caution to mitigate potential biases in estimating attribution effects. Figure 1 presents a schematic summary of the quasi-randomized controlled trial (RCT) design employed by IFPRI.

To the extent the program improves adoption of SI innovations and subsequent outcomes also among non-beneficiary households, ignoring spillovers would lead to underestimation of program effect and, consequently, possible bias in policy suggestions. Given the non-random selection of AR sites and households, comparison of outcomes between AR households and non-beneficiary households (in AR villages) and between AR households and control households (in non-AR villages) will capture not only direct effects of adoption of SI innovations, but also spillover effects. During initial stages of the program when the time lapse is relatively short to expect strong program spillovers, non-beneficiary households can be used as a within-village control group to estimate the expected effects of adoption of SI innovations on short-term outputs and outcomes.

Figure 1 AR evaluation design



*Different colours associated to the villages denote homogeneous agricultural potential areas.
**This evaluation design has been adapted to each program country depending on the design and the stage of the research activities, as well as availability of resources at the time of the implementation of Africa RISING Baseline Evaluation Surveys.

While some elements of the evaluation design may vary across program countries, this general design involved the following main steps.[6]

1. Stratification of geographic areas and creation of agricultural potential domains based on agro-ecology.
2. Selection of AR action sites from within the delineated agricultural potential domains (by AR researchers).
3. Identification of control sites in the same domain as selected action sites but reasonably far apart to mitigate potential contamination (in collaboration with AR researchers).
4. Household listing exercise to compile the list of all agricultural households in the selected (action and control) communities.[7]
5. Random sampling of households in control sites (control households) to serve as a valid counterfactual to AR beneficiary households.
6. Purging of AR beneficiary households from the household list for AR action sites in order to prepare a household list that *excludes* AR beneficiary households.
7. Random sampling of non-beneficiary households from with action sites using the sampling frame constructed in (6). Data from non-beneficiary households will be used to examine potential spillovers, as shown in Figure 1.[8]
8. Collection of socioeconomic baseline (completed) and follow-up data (to be collected) from program beneficiary, control, and non-beneficiary households and communities.
9. Compare various agro-economic and environmental outcomes of interest among AR beneficiary, non-beneficiaries, and control households using baseline as well as follow-up data through multivariate regression analysis and other econometric techniques (e.g., matching).

Main evaluation-related activities accomplished 2011-2015

A summary of the major evaluation-related tasks undertaken by IFPRI (with support for AR research teams) is summarized in Table 2.

[6] The quasi-RCT design differs across Mali, Ghana, and Ethiopia in the following ways: in Mali, only AR beneficiaries and control households were surveyed. In Ghana, in addition to a sub-sample of 2013 AR beneficiaries, non-beneficiaries, and control households, a sample of expected AR beneficiaries (in 2014) were surveyed. In Ethiopia, only AR and non-beneficiaries were surveyed. Please refer to the 2014 M&E report for the detail on country-specific evaluation designs.
7 Whenever household lists are available from secondary sources, verification of household list was done by the M&E team.
[8] In this report, spillovers refer to a situation where farmers not eligible to receive SI innovations, or who are eligible to receive the intervention but have not yet received it, benefit from the intervention indirectly through a variety of ways – such as externalities (e.g., when channeled by successful AR farmers), general equilibrium effects (e.g., depressed maize price through increased maize production), social and economic interactions (e.g., neighbors and relatives interacting with and learning from current adopters of SI innovations), and behavioral changes.

Table 2 Main evaluation-related activities undertaken 2011-2015

Activity	Remark
Characterization and stratification of target farming systems	GIS information used
Selection of counterfactual communities and households	Through site visits and local help from AR researchers
Designing of Africa RISING Baseline Evaluation Surveys (ARBES) and implementation	Main tasks include power calculation, household listing, sampling, programming and piloting of survey tools, training, data collection
Cleaning, aggregation, and sharing ARBES data	These data have been aggregated to the household, farm, plot, and crop levels and shared with several AR and non-AR researchers. See Appendix B.
Data analysis and production of several research outputs such as reports and papers	Data analysis has been produced and shared through various presentations. Multiple research outputs have been generated (summarized in Appendix C) and presented at local and regional AR events as well as at international conferences. The studies are currently being refined for further diffusion and journal publication.

Proposed evaluation activities by IFPRI

The summary list below highlights AR evaluation-related activities IFPRI proposes to undertake in Phase II, building upon the Institute's (and the team's) comparative advantage in using ex-ante and ex-post evaluation methods, and considering IFPRI's mission to conduct high-quality and relevant agricultural research. Please refer to Appendix C for details.

a. Farming systems, typology, livelihood, and poverty characterization analysis

Descriptive analysis can be a crucial source of information for AR project management, and the M&E team is best placed to conduct household characterization, generate household typologies, analysing livelihood strategies using the detailed household and community data collected as part of ARBES. The M&E team expects to invest more time on collaborative research with Wageningen University (WUR) and AR researchers to exploit synergies. Currently, IFPRI has produced draft typology reports for the program countries using ARBES data. In addition, IFPRI will be supporting AR researchers in the exploration of ARBES data files.

b. Ex-ante and ex-post evaluation of AR innovations

In spite of the limitations of (early) evaluation using cross-sectional data (as opposed to panel data), the team will be refining the analysis of the expected effects of AR innovations by using ARBES survey and spatially-explicit biophysical and socioeconomic data. IFPRI will provide evidence on both the expected overall effects of AR interventions as well as of specific mix of SI innovations, when sample size allows and adequate information is available. This evaluation effort will be complementary to any cost-benefit analysis (CBA). Indeed, CBA is based on static economic accounting of costs and benefits of the project/programme, while our evaluation will follow the guidelines of an impact assessment due to a change in farmers' behaviour. In addition to ex-post

evaluation, the team will assess the ex-ante potential impacts of wide adoption of SI technologies and management practices across the Feed the Future Zone of Influence in programme countries through: 1. crop modeling framework development; 2. integrated modeling framework development; 3. case study development and presentation. The fully developed, calibrated integrated modeling framework will contribute to support AR partners to answer to research questions on the potential impacts of adopting SI technologies and practices, systemically compared against the model-estimated counterfactuals. The list of ongoing research activities is reported in Appendix C.

c. Follow-up evaluation surveys to conduct relevant applied research using panel data identification strategies

IFPRI has collected detailed micro data as part of its baseline evaluation surveys. In order to assess progress and medium-term program effects, the team expects to implement shorter and more focused follow-up surveys in Phase II. Data from these surveys will be combined with baseline data to provide a more robust empirical evidence on agronomic and socioeconomic effects of AR innovations using panel data identification strategies. IFPRI will collaborate with AR colleagues to identify and rank SI innovations that are being tested by analysing relevant socio-economic and spatial data collected by both IFPRI and AR researchers over time. IFPRI is currently collaborating with IITA (primarily with its Tamale-based agricultural economist) on a nutrition study and expects to initiate more collaborations, especially in the area of cost-benefit analysis of AR innovations.

d. Targeted case studies and experiments to guide new research streams

Given the multifaceted, demand-driven nature of the AR program, and the decentralized delivery of SI innovations, a careful attribution of each mix of SI innovations is extremely challenging. On the other hand, accurate attribution is crucial to guide scaling up efforts and generate evidence on how best to ensure sustained adoption of SI innovations, over and above the life of Africa RISING. Therefore, IFPRI's proposal is to undertake targeted case studies and experiments to elicit farmers' willingness to pay for SI innovations, examine the determinants of their adoption, and better understand heterogeneity in farmers' demand for these innovations. These case studies will follow the Cereal Systems Initiative for South Asia (CSISA) model, where significant advances have been made in the analysis of demand for specific mix of innovations. See extended abstracts in Appendix C for an ongoing case study in Tanzania on willingness to pay for improved technologies that can be replicated to other countries depending on availability of resources.

e. Risk rationing, access to credit, and adoption of agricultural technologies

Risk preference and access to credit are among the factors that have been found to contribute to the low adoption rate of technologies (such as seed, fertilizer) that are deemed profitable by their promoters (Foster and Rosenzweig, 2010 & 2004, Duflo et al. 2008, and Suri, 2011). Credit constraints may have negative impacts on poor households that can force some households fall into poverty traps (Zimmerman and Carter 2003; Carter and Barrett 2006). The use of credit can be low due to supply-side factors (e.g., households are willing to borrow at the prevailing interest rate but they are unable to get credit), demand side factors (e.g., households not willing to borrow at the prevailing rate due to uncertainties about expected returns and hence their ability to repay the loan)

or both. While disentangling role of the different factors is crucial to identify policy options to promote agricultural and rural development, doing so empirically is often challenging. To examine this further, and based on an ongoing case study in the Babati region of Tanzania, we estimate households' credit demand elasticities. Specifically, we investigate the typology and prevalence of credit rationing including risk rationing, analyse the determinants of each typology of credit rationing behaviour, and evaluate the impacts of credit constraints (including risk rationing) on agricultural productivity and other outcome variables of farm households.

f. Inform scaling up efforts

Building upon evidence generated from (a)-(e) and using spatially explicit biophysical and socioeconomic data available in-house, IFPRI has a comparative advantage to assess the representativeness of AR communities up to the FtF zone of influence. The analysis will involve both ex-ante and ex-post evaluation and will generate evidence on what would happen if current AR technologies were to be scaled up within the FtF zone of influence. Effects will be assessed on productivity, income, poverty, nutrition, and the environment. To help interpret findings from ARBES surveys within a wider context, IFPRI will examine various secondary sources that are representative at a national level, tapping into the team's large database of micro-data holdings.

Conclusions

Based on the experience over the period 2011-15, the IFPRI M&E team recommends refreshing its mandate and overall scope of work to closely reflect the role the Institute is best suited to play, avoid possible misalignments of expectations and deliver high-quality products that could effectively serve the program. The M&E team expects to continue engaging in activities in which it has a comparative advantage, such as rigorous impact evaluation, geospatial analysis and research on food security, using ex-post impact assessment methodologies, in addition to ex-ante simulation and geospatial processing tools. At the same time the team will have a constant presence in all AR countries through the locally-recruited M&E officers and data managers, supervising the time-and resource-intensive monitoring of researchers' outputs. Table 3 below summarizes the main monitoring and evaluation tasks IFPRI proposes and expects to accomplish in Phase II, jointly with other researchers within and outside AR.

Through systematic synthesis of socioeconomic and spatially-explicit biophysical data and using both ex-ante and ex-post evaluation looking at various SI innovations, IFPRI expects to generate empirical evidence on various topics including, but not limited to, characteristics and typology of AR households and villages; predicted effects on agro-economic outputs and outcomes, implications for scaling up, and ranking of AR innovations, which are being identified and tested, based on desirable agronomic and environmental traits (to be) defined by AR colleagues.

In addition, results from the typology and evaluation exercises will help identify successful AR innovations and aid with scaling up efforts. AR programme benefits by biophysical researchers experts and knowledgeable about agronomic research design, so IFPRI's role should be limited to the monitoring activities outlined above, and analysis of various micro- and biophysical data including sharing of findings with all AR stakeholders using different outlets. The expected budget for these activities is reported in Appendix D.

Table 3 Monitoring (M) and evaluation (E) activities to be undertaken

Activity	Remark
Project monitoring, and PMMT maintenance (M)	To be achieved through the PMMT and in-person interactions with AR researchers
Trainings to assist with project monitoring (M)	Additional in-country PMMT trainings
FtF aggregation and submission (M)	PMMT aggregation of single projects into regional level indicators
Beneficiary Tracking System (BTS) (M)	Jointly with all the AR stakeholders
Cataloguing of AR innovations (M)	In collaboration with AR 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 AR teams, other researchers in IFPRI (Biosight, HarvestChoice) and other bio-physical modellers (CIHEAM-IAMM), using DAHBSIM and DSSAT models. See Appendix C for details. Analysis is on-going for Malawi, progressively expanding to the other program countries.
Data analysis for e**x-post evaluation** (E)	Also jointly with other CG 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)	See Appendix C for the detail.

Appendix A. Meta-data submitted and uploaded onto CKAN (as of April 21, 2016)

No.	Template sender's full name	Country	CKAN code
1	Mekonnen, Kindu (ILRI)	Ethiopia	growth-and-biomass-of-tree-lucerne
2	Roberts, Cleo (IFPRI)	Ethiopia	eth_arbes
3	Adie, Aberra (ILRI)	Ethiopia	faba_analysis
4	Aster Gebrekirstos (ICRAF)	Ethiopia	tree-crop-livestock-systems-in-the-ethiopian-highlands-endamahoni-woreda-tigray-region
5	Aster Gebrekirstos (ICRAF)	Ethiopia	tree-crop-livestock-systems-in-the-ethiopian-highlands-sinana-woreda-oromo-region
6	Aster Gebrekirstos (ICRAF)	Ethiopia	tree-crop-livestock-mixed-systems-ethiopia
7	Aster Gebrekirstos (ICRAF)	Ethiopia	tree-crop-livestock-mixed-systems-in-basona-woreda-amhara-region
8	Birachi, Eliud Abucheli (CIAT-Kenya)	Ethiopia	value_chain_analysis_eth
9	Damtew, Elias (ILRI)	Ethiopia	innovation_platform_m_e
10	Derseh, Melkamu (ILRI)	Ethiopia	crop_residue_mgm
11	Derseh, Melkamu (ILRI)	Ethiopia	irr_rain_fodder
12	Lema, Zelalem (ILRI)	Ethiopia	innovation_platform_design
13	Sharma, Kalpana (CIP-Ethiopia)	Ethiopia	diffused_light_storage
14	Sharma, Kalpana (CIP-Ethiopia)	Ethiopia	community_action_plan
15	Sharma, Kalpana (CIP-Ethiopia)	Ethiopia	ar_integration
16	Sharma, Kalpana (CIP-Ethiopia)	Ethiopia	quality_seed_promotion
17	Sharma, Kalpana (CIP-Ethiopia)	Ethiopia	seed_multiplication
18	Thorne, Peter (ILRI)	Ethiopia	participatory_selection
19	Groot, Jeroen (WUR)	Ghana	rapid-characterisation-of-farming-systems-in-africa-rising-wur-rapid
20	Roberts, Cleo (IFPRI)	Ghana	gha_arbes
21	Kotu, Bekele (IITA)	Ghana/Mali	scaling-up-sustainable-cropping-practices-zia-and-micro-dosing
22	Kotu, Bekele (IITA)	Ghana/Mali	crop-diversification-in-maize-based-cropping-system-maize-sesame-intercropping
23	Kotu, Bekele (IITA)	Ghana/Mali	improved-varieties-and-agronomic-practices-using-the-mother-baby-approach

No.	Template sender's full name	Country	CKAN code
24	Kotu, Bekele (IITA)	Ghana/Mali	test-and-disseminate-technologies-to-intensity-vegetable-mono-cropping
25	Traore, Marc (ICRISAT)	Ghana/Mali	conventions_survey
26	Chikowo, Regis (MSU)	Malawi	africa-rising-malawi-phosphorus-fertilization-in-legume-systesms
27	Chikowo, Regis (MSU)	Malawi	africa-rising-malawi-increase-dairy-production-through-improved-fodder
28	Chikowo, Regis (MSU)	Malawi	africa-rising-malawi-productivity-of-maize-after-legumes
29	Chikowo, Regis (MSU)	Malawi	africa-rising-malawi-pigeonpea-above-and-below-ground-biomass-inputs
30	Chikowo, Regis (MSU)	Malawi	africa-rising-malawi-yield-cuts-survey
31	Chikowo, Regis (MSU)	Malawi	africa-rising-malawi-grain-legumes-producity-in-different-crop-arrangments
32	Chikowo, Regis (MSU)	Malawi	africa-rising-malawi-Pigeonpea-productivity_pigeonpea-parameters
33	Chikowo, Regis (MSU)	Malawi	africa-rising-malawi-CIAT-bean-integration-data-for-2013-15
34	Groot, Jeroen (WUR)	Malawi	http://data.ilri.org/portal/dataset/rapid-characterisation-of-farming-systems-in-africa-rising-malawi
35	Roberts, Cleo (IFPRI)	Malawi	mwi_arbes
36	Groot, Jeroen (WUR)	Mali	rapid-characterisation-of-farming-systems-in-africa-rising-mali
37	Roberts, Cleo (IFPRI)	Mali	mli_arbes
38	Traore, Marc (ICRISAT)	Mali	mali_trials
39	Traore, Marc (ICRISAT)	Mali	mali_sheep_feeding
40	Traore, Marc (ICRISAT)	Mali	mali_farm
41	Traore, Marc (ICRISAT)	Mali	mali_biomass
42	Traore, Marc (ICRISAT)	Mali	houehold_farmer_survey
43	Traore, Marc (ICRISAT)	Mali	nutrition_modules
44	Traore, Marc (ICRISAT)	Mali	feed_evaluation
45	Traore, Marc (ICRISAT)	Mali	nutrition_survey
46	Afari-Sefa, Victor (AVRDC)	Tanzania	integration-of-vegetables-into-maize-based-farming-systems-in-babati-cba
47	Afari-Sefa, Victor (AVRDC)	Tanzania	integration-of-vegetables-into-maize-based-farming-systems-in-babati-cba

No.	Template sender's full name	Country	CKAN code
48	Afari-Sefa, Victor (AVRDC)	Tanzania	integrating-vegetables-into-maize-based-systems-scoping-study
49	Afari-Sefa, Victor (AVRDC)	Tanzania	integrating-vegetables-into-maize-based-systems-scoping-study
50	Doyle, Danny	Tanzania	
51	Groot, Jeroen (WUR)	Tanzania	rapid-characterisation-of-farming-systems-in-africa-rising-tanzania
52	Kimaro, Anthony (ICRAF)	Tanzania	africa-rising-tanzania-intesifying-maize-piegeon-intercropping-system-through-p-fertilization
53	Kimaro, Anthony (ICRAF)	Tanzania	analysis-of-soil-related-constraints-for-sustainable-intensification
54	Kimaro, Anthony (ICRAF)	Tanzania	africa-rising-tanzania-intensifying-maize-based-cropping-systems-through-pigeonpea-integrations
55	Kimaro, Anthony (ICRAF)	Tanzania	africa-rising-shelterbelt
56	Kimaro, Anthony (ICRAF)	Tanzania	Africa RISING Tanzania - Simulating adoption study
57	Kumar, Lava (IITA)	Tanzania	management-of-maize-lethal-necrosis-mln-in-tanzania
58	Roberts, Cleo (IFPRI)	Tanzania	tza_arbes
59	Savini, Isaac (CIAT)	Tanzania	estimate-difference-in-yield-between-farmers-current-practices-and-management-strategies
60	Savini, Isaac (CIAT)	Tanzania	promoting-sustainable-intensification-through-efficient-application-of-phosphorus
61	Savini, Isaac (CIAT)	Tanzania	maize-and-pigeonpea-intercropping
62	Savini, Isaac (CIAT)	Tanzania	soil-survey-to-characterize-2-sentinel-sites
63	Sikumba, Gregory (ILRI)	Tanzania	July 2015 Forage chopper farmer perception Dataset
64	Sikumba, Gregory (ILRI)	Tanzania	Africa Rising Babati poultry survey data and Metadata BL
65	Sikumba, Gregory (ILRI)	Tanzania	africa-rising-tanzania-feed-assessment-feast-babati-tanzania
66	Sikumba, Gregory (ILRI)	Tanzania	improved-forages
67	Abass, Adebayo (IITA)	Tanzania	post_harvest_food_loss
68	Manda, Julius (IITA)		monitoring-adoption-survey

AVRDC = The World Vegetable Center; CIAT = International Center for Tropical Agriculture; CIP = International Potato Center; ICRAF = World Agroforestry Centre; ICRISAT = International Crops Research Institute for the Semi-Arid Tropics; IFPRI = International Food Policy Research Institute; IITA = International Institute of Tropical Agriculture; ILRI = International Livestock Research Institute; MSU = Michigan State University; WUR = Wageningen University

Appendix B. Africa RISING Data Requests (as of April 21, 2016)

Requestor's name	Requestor's organization	Country of data request
Abiy Yilma	University student	Ethiopia
Ati van der Honing	WUR	Ethiopia
Jeroen Groot	WUR	Ethiopia
Jeroen Groot	WUR	Ethiopia
Mirja Michalscheck	WUR	Ethiopia
Mirja Michalscheck	WUR	Ethiopia
Molla	Unknown	Ethiopia
Solomon Negash	University of Oslo	Ethiopia
Tilahun Amede	ICRISAT	Ethiopia
Vine Mutyasira	CSU	Ethiopia
Bekele Kotu	IITA	Ethiopia, Ghana, Malawi, Mali, Tanzania
Neville Clarke	TAMU	Ethiopia, Ghana, Malawi, Mali, Tanzania
Shaibu Mellon	IITA	Ethiopia, Ghana, Malawi, Mali, Tanzania
TAMU student	TAMU	Ethiopia, Ghana, Malawi, Mali, Tanzania
Davie Kadyampakeni	IWMI	Ghana
Dennis Ondieki	WUR	Ghana
Jeroen Groot	WUR	Ghana
Mauricio Bellon	Bioversity	Ghana
Mirja Michalscheck	WUR	Ghana
Adam Komarek	IFPRI	Malawi
James Hawkins	IFPRI	Malawi
Dave Harris	Independent Consultant	Malawi
Guillermo Flichman	IAMM (France)	Malawi
Hatem Belhouchette	IAMM (France)	Malawi
MSU student	MSU	Malawi
MSU student	MSU	Malawi
Roza Chenoune	IAMM (France)	Malawi
Sieglinde Snapp	MSU	Malawi

Requestor's name	Requestor's organization	Country of data request
IFPRI staff	IFPRI	Malawi, Ghana
Jeroen Groot	WUR	Malawi, Ghana
Mirja Michalscheck	WUR	Malawi, Ghana
Bekele Kotu	IITA	Malawi, Tanzania
Isaac Jambo	WUR	Malawi, Tanzania
Jeroen Groot	WUR	Malawi, Tanzania
Shaibu Mellon	IITA	Malawi, Tanzania
Mary Ollenburger	ICRISAT/WUR	Mali
Pascal Tillie	European Commission	Mali
Alejandra Aponte	Georgetown University	Tanzania
Alejandra Arrieta	Georgetown University	Tanzania
Asad Zaman	Georgetown University	Tanzania
Gregory Sikumba	ILRI	Tanzania
Gundula Fischer	IITA	Tanzania
Jacobus Cilliers	Georgetown University	Tanzania
Jean-Claude Bizimana	TAMU	Tanzania
Job Kihara	IITA	Tanzania
Peter Maclean	Unknown	Tanzania
Rohit Chhabra	Georgetown University	Tanzania

CSU = Colorado State University; IAMM = Institut Agronomique Méditerranéen de Montpellier; ICRISAT = International Crops Research Institute for the Semi-Arid Tropics; IFPRI = International Food Policy Research Institute; IITA = International Institute of Tropical Agriculture; ILRI = International Livestock Research Institute; MSU = Michigan State University; TAMU = Texas A&M University; WUR = Wageningen University

Appendix C. Agro-economic and spatial analysis within Africa RISING program

Targeting, bias, and expected impact of complex innovations

Developing-country initiatives on sustainable intensification (SI) and climate-smart agriculture (CSA) revolve primarily around the promotion of complex systems-based technologies and management practices that simultaneously improve yields and conserve natural resources. Many agronomic evaluations of these technologies have been conducted under near-perfect experimental conditions to provide precise measures of physical inputs and outputs. However, few evaluations have been run under analogous social experimental conditions in which farmers make constrained optimization decisions. As a result, researchers, policymakers, and donors are involved in sustainable intensification programs that rely on studies administered among purposively selected group of farmers—typically those who are more likely to successfully adopt the proposed technologies for a sustained period of time. This approach opens the door to potentially 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, we use a quasi-experimental approach integrated with data from geographic information systems to evaluate a SI/CSA project in Malawi that is testing complex systems-based technologies aimed at improving whole-farm productivity, livelihoods, and food security. Preliminary results suggest the likely presence of selection bias by showing how socioeconomic characteristics of beneficiaries are systematically different than non-beneficiary's. Using a multivalued treatment effects approach, we show higher expected maize yield and value of harvest across all quantiles of the distributions for project beneficiaries compared to control households. We also find evidence of potential systematic targeting of villages and households. Overall, these findings point to the need to rethink how SI/CSA initiatives identify and select project beneficiaries, something that could bear potentially severe implications upon scaling up. Similar analysis will be carried out for other AR countries progressively.

Characterizing adopters of sustainable intensification innovations

Supporting the world's projected nine billion people by 2050 necessitates increased production of food, feed, and bioenergy sources. This in turn is expected to put significant pressure on the environment and natural resources on which millions of poor people rely heavily and directly for their livelihood. Africa Research in Sustainable Intensification for the Next Generation (Africa RISING) is a research-for-development program that aims to create opportunities for smallholder farmers to move out of hunger and poverty through sustainable intensification of their farming systems. Given the program's focus on demand-driven innovations that are likely to identify best-bet interventions to reach the highest possible number of beneficiaries, successful scaling up of the program necessitates evidence on what works and for whom. Using geographic information systems and household survey data from two of the program countries – Malawi and Tanzania – we 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. We find target villages to differ from non-target villages along some biophysical and economic dimensions, such as access to market and agricultural extension services. Beneficiaries in both countries to differ from non-beneficiaries along several dimensions: they are better educated, have larger family size, own more farm and household durable assets, have bigger land size, are more likely to own livestock, and have better quality housing, among other things. Beneficiaries also used more agricultural inputs, were more likely to practice intercropping and crop rotation and benefited of higher yields in the previous harvesting season. These findings highlight the need to rethink targeting criteria for Africa RISING and possibly other systems-based innovations, something that could potentially bear severe implications upon scaling up. Not only could adoption rates of agricultural innovations be low, but subsequent outputs and outcomes may be lower than expected when being scaled up to the broader, less endowed smallholder farmer population.

Assessing farmers' willingness to pay for agricultural innovations

Existing empirical evidence suggests the presence of several socioeconomic constraints to adoption of improved agricultural technologies. For example, Matuschke, Mishra and Quaim (2007) find that access to information, individual networks, and income/access to credit matter for the adoption of hybrid wheat in India. Bandiera and Rasul (2006) show that for the introduction of a new crop (sunflower) in Mozambique, social learning effects are U-shaped, that is, when there are many adopters, individuals may have incentives to strategically delay their own adoption decision, until the results of their neighbors' adoption decision have materialized. In Kenya, Duflo, Kremer and Robinson (2011) find that it is not a credit constraint that is preventing farmers from buying fertilizer (which previous work by the same authors had shown to be a profitable investment in the context, see Duflo, Kremer and Robinson (2008)), but rather present-bias and procrastination: The authors find that a small nudge (a time-limited offer of free delivery of fertilizer) can induce farmers to buy fertilizer. Calibrations of their model suggest that such a nudge may produce better welfare outcomes than not intervening in the market or intervening more heavily (subsidized purchase price).

Weather and market risks and limited access to credit in agriculture are not only serious impediments to agricultural productivity, but also remain two of the main sources of poverty trap in developing countries. The proposed research aims to provide evidence on sustainable ways to help farmers manage downside risks in agriculture and overcome credit constraints through risk-contingent credit (RCC). RCC is an innovative financial instrument that embeds within its structure insurance protection which, when triggered, offsets loan payments due to the lender. RCC can protect farmers from adverse weather and market price risks as well as provide formal credit access for investment in agriculture and related capital and activities. We will develop and implement two financial products targeted to maize and legumes farmers to cover weather and market price risk. The first is RCC with imbedded weather insurance, and the second is RCC with imbedded price insurance. The outcome of this project will be formal design and development of RCC products that will impact welfare and development of farming community. Indeed, our innovation is a financial product embedding an insurance component that mitigates risks in agriculture, supporting production at times of negative shocks. The aim is also that, with the insurance component embedded in the credit product, lenders will reduce (or eliminate) collateral requirements, thus

increasing demand by poor and risk-rationed smallholders farmers. Outcomes and expected impact pathway we expect from this research are identification of alternative options to alleviate credit constraints and enhanced technology adoption (e.g., of climate-smart agricultural practices) and subsequent benefits thereof.

Using a prospective multi-arm randomized evaluation design in Tanzania (Babati district), this ongoing research aims to elicit farmers' willingness to pay for improved agricultural technologies as well as the role of farmers' attitudes toward risk and credit constraints. . Evidence from this research is expected to contribute to the broader literature on adoption, diffusion, and impact of improved innovations.

Bio-economic modelling of household farm production and its linkages to the environment

During 2014-15, IFPRI (through the BioSight project) has been engaged with key partners at the Institute for Advanced Studies of Agronomy in the Mediterranean (CIHEAM-IAMM) to develop a new dynamic, household-farm bio-economic simulation model, called "DAHBSIM". This effort represents an evolution from previous models built by the researchers at CIHEAAM-IAMM, and incorporates closer feedbacks between crop productivity, soil conditions, farm-level profitability, and livestock in a much explicit way. Malawi was chosen as the first country case-study, in order to provide a "proof-of-concept" for how to advance bio-economic modelling of household farm production and its linkages to the environment, while other countries will likely be analysed in the future, The "DAHBSIM" model has been constructed around household-level data from Africa RISING project in Malawi, and contains distinct typologies of farm households that capture the heterogeneity observed in the sample. Using DAHBSIM, we 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 be a combination of individual or combined effects of two main types of driving forces: i) socio-economic, policy and market changes (e.g., prices of inputs and outputs, availability of land and labour, agricultural and water policies), and ii) 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 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) indicators 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 carrying out ex ante evaluation on various technologies, and powerful synergies between the evaluation work being carried out by both teams. Pending availability of resources, the team expects to expand DAHBSIM analysis to other Africa RISING countries to capture different economic and agro-ecological contexts.

Assessing farm-level trade-offs between organic and inorganic nitrogen fertilizers

Using Africa RISING data from Malawi as a case study, this research will combine crop modelling (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 survey data from Malawi to calibrate DSSAT simulations at the pixel level will be available, similar work is expected to be conducted in other Africa RISING countries. This research is a collaborative work between Biosight, HarvestChoice, and Africa RISING M&E teams at IFPRI.

Assessing the interdependence between land use and land cover changes and welfare

The objective of this ongoing study is to examine the interdependence between land cover changes and welfare combining data from household surveys, remote sensing, and GPS measurement of specific parcels. 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, and a careful examination of potentially different trajectories of land cover and poverty is crucial to dive deeper on the causality mechanism. Using ARBES data collected in North Ghana, this study will examine dynamics of land cover changes over the last two decades, assess the independent effects of different 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.

Nutrition-sensitive agricultural interventions

Food and nutrition security are important outcomes that can be supported by the sustainable intensification of agriculture. Using both production and consumption data from Africa RISING Baseline Evaluation Survey, 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 as both quantity and nutrient content of food consumed. As food and nutrition security are associated with dietary quality and diversity, the team will investigate whether crop diversity and productivity translate into dietary diversity, and how effective are these two strategies comparatively. Undernutrition is a major policy concern whose implications go beyond the simple overall lack of food as it bears on health and households' general well-being, poor school performance, and low work capacity. It refers to both insufficient quantity and insufficient quality of food. Undernutrition generally results in protein-energy malnutrition, which retards physical and mental development. In addition to undernutrition, inadequate intake of micronutrients has a negative effect on health in many ways, such as inadequate growth, cognitive delays, vulnerability to infection, and low productivity. IFPRI is coordinating with IITA-Ghana to scope out areas of collaboration, and IITA-Ghana is also partnering with Bioversity International on a nutrition study to which IFPRI can actively contribute.

Climate Smart Agriculture

The IFPRI team is collaborating with the Economics of Sustainable Agricultural Systems Team (ESAS) of the Food and Agriculture Organization of the United Nations (FAO) on CSA themes of mutual interest. Potential collaborative activities include analysis of data to provide empirical evidence on topics such as determinants of adoption of CSA practices, the effects of such strategies on agricultural output (such as yield and ecosystem services).

Technology diffusion and scale-up

Building upon evidence generated over time and using spatially-explicit biophysical and socioeconomic data, the M&E team will study the spatial diffusion of AR innovation being tested, and eventually scaled up, taking the statistical representativeness of AR communities into account. The analysis will take advantage of nationally-representative household surveys to construct synthetic cohorts of households similar to AR beneficiary farmers. Effects will be assessed on productivity, income, poverty, nutrition, and the environment.