



# Africa RISING Project in Ethiopian Highlands Work Plans – 2015-2016

## Contents

<b>Title: Diagnosis and characterization of the most important constraints that hinder women and marginalized groups from achieving full productivity potential and income generation .....</b>	<b>7</b>
Theme.....	7
Activities Addressed .....	7
Justification .....	7
Research Methods.....	7
Deliverables .....	8
Research Outcome .....	8
Partners and Indicative Budget .....	8
<b>Title: Stepwise Intensification Options for Small-scale Faba Bean / Forage Production Systems. ....</b>	<b>9</b>
Theme.....	9
Activities Addressed .....	9
Justification .....	9
Research Methods.....	9
Deliverables .....	10
Research Outcomes.....	11
Partners and Indicative Budget .....	11
<b>Title: Assessing importance of animal health constraints in mixed crop-livestock systems and farmers' understanding of infectious diseases. ....</b>	<b>12</b>
Theme.....	12
Activities Addressed .....	12
Justifications.....	12
Research Methods.....	12
Deliverables .....	13
Partners and Indicative Budget .....	13
<b>Title: Factors governing the use of improved forage and forage seed at smallholder level in the Ethiopian highlands .....</b>	<b>14</b>
Theme.....	14
Activities Addressed .....	14
Justification .....	14
Research Methods.....	14
Research outcomes .....	15



Deliverables .....	15
Partners and Indicative Budget .....	15
<b>Title: Identifying sustainable forage seed production and marketing models for Ethiopia .....</b>	<b>16</b>
Theme.....	16
Activities Addressed .....	16
Justification .....	16
Research Methods.....	17
Research outcomes .....	17
Deliverables .....	17
Partners and Indicative Budget .....	17
<b>Title: Participatory evaluation of techniques to improve the utilization of crop residues by farm households.....</b>	<b>18</b>
Theme.....	18
Activities Addressed .....	18
Justification .....	18
Research Methods.....	18
Deliverables .....	19
Research Outcomes.....	19
Partners and Indicative Budget .....	20
<b>Title: Supplemental fodder production to improve livestock productivity in the Africa RISING sites .....</b>	<b>21</b>
Theme.....	21
Activities Addressed .....	21
Justification .....	21
Research Methods.....	22
Deliverables .....	22
Research Outcomes.....	22
<b>Title: Design and test processes to foster learning and identify knowledge pathways to disseminate agricultural innovations in Africa RISING sites.....</b>	<b>24</b>
Theme.....	24
Activities Addressed .....	24
Justification .....	24
Research Methods.....	25
Deliverables .....	25
Research Outcomes.....	25
Partners and Indicative Budget .....	26
<b>Title: Integrating tree lucerne (<i>Chamaetysius palmensis</i>) in the crop-livestock farming systems of the Ethiopian highlands for multiple products and services .....</b>	<b>27</b>
Theme.....	27
Activities Addressed .....	27
Justification .....	27
Research Methods.....	28
Deliverables .....	28
Research Outcomes.....	29
Partners and Indicative Budget .....	29



**Title: Enhancing and monitoring impacts of complementary and linked land and water management technologies and approaches at landscape/ watershed levels.....30**

Theme.....	30
Activities Addressed .....	30
Justification .....	30
Research Methods.....	31
Deliverables .....	32
Research Outcomes.....	32
Partners and Indicative Budget .....	33

**Title: Facilitating market linkages between farmer agribusinesses with key buyers for potato, faba bean and wheat in the Africa RISING Ethiopia project .....34**

Theme.....	34
Activities Addressed .....	34
Justification .....	34
Research Methods.....	34
Deliverables .....	35
Research Outcomes.....	35
Partners and Indicative Budget .....	35

**Title: Facilitating market linkages between farmer agribusinesses with key buyers for potato, faba bean and wheat in the Africa RISING Ethiopia project .....37**

Theme.....	37
Activities Addressed .....	37
Justification .....	37
Research Methods.....	37
Deliverables .....	38
Research Outcomes.....	38
Partners and Indicative Budget .....	38

**Title: Evaluating the costs and benefits of potato seed businesses in the Africa RISING Ethiopia project.....40**

Theme.....	40
Activities Addressed .....	40
Justification .....	40
Research Methods.....	40
Deliverables .....	41
Research Outcomes.....	41
Partners and Indicative Budget .....	41

**Title: Evaluating the viability of a commercial spraying and mechanization services in the Africa RISING Ethiopia project.....43**

Theme.....	43
Activities Addressed .....	43
Justification .....	43
Research Methods.....	43
Deliverables .....	44
Research Outcomes.....	44
Partners and Indicative Budget .....	44

**Title: Addressing the yield gap challenge in the Ethiopian highlands through improved management practices .46**

Theme.....	46
Activities Addressed .....	46
Justification .....	46
Research Methods.....	46
Deliverables.....	47
Research Outcomes.....	47
Partners and Indicative Budget .....	48

**Title: Strengthening national capacities in monitoring, evaluation and communication of soil fertility management practices that counteract soil fertility depletion .....49**

Theme.....	49
Activities Addressed .....	49
Justification .....	49
Research Methods.....	50
Deliverables.....	50
Research Outcomes.....	51
Partners and Indicative Budget .....	51

**Title: Participatory evaluation of techniques to introduce the utilization of dual-purpose cereals by farm households .....53**

Theme.....	53
Activities Addressed .....	53
Justifications.....	53
Research Methods.....	54
Deliverables.....	54
Research Outcomes.....	54
Partners and Indicative Budget .....	55

**Title: Smart marketing of small ruminants in selected Africa RISING sites of Central Ethiopia.....56**

Theme.....	56
Activities Addressed .....	56
Justification .....	56
Research Methods.....	56
Deliverables.....	57
Research Outcomes.....	57
Partners and Indicative Budget .....	58

**Title: Optimal temporal and spatial tree crop livestock system integration for improved yield, biomass, nutrient cycling, energy efficiency and carbon sequestration .....59**

Theme.....	59
Activities Addressed .....	59
Justification .....	59
Research Methods.....	60
Deliverables.....	61
Research Outcomes.....	61
Partners and Indicative Budget .....	61

<b>Title: Reaching wider communities with Stratified, Land Quality based Fertilizer Recommendation in Ethiopia: evidence for policy influence.....</b>	<b>63</b>
Theme.....	63
Activities Addressed .....	63
Justification .....	63
Research Methods.....	64
Deliverables.....	64
Research Outcomes.....	65
Partners and Indicative Budget .....	65
<b>Title: Farm-typology based Interventions for Improved Nutrition, Income and Resilience in AfricaRISING sites, Ethiopia .....</b>	<b>66</b>
Theme.....	66
Activities Addressed .....	66
Justification .....	66
Research Method .....	67
Deliverables.....	67
Research Outcomes.....	68
Partners and Indicative Budget, 2015/2016.....	68
<b>Title: Chickpea Innovations to Save Crop-livestock Farmers in Ethiopian Highlands from Devastating Effects of Unknown Faba bean disease .....</b>	<b>69</b>
Theme.....	69
Activities Addressed .....	69
Justification .....	69
Research Methods.....	70
Deliverables.....	70
Research Outcomes.....	71
Partners and Indicative Budget .....	71
<b>Title: Capacity Assessment and Development in Agricultural Water Management to ensure Sustainability of technologies .....</b>	<b>72</b>
Theme.....	72
Activities Addressed .....	72
Justification .....	72
Research Methods.....	72
Deliverables.....	73
Research Outcomes.....	73
Partners and Indicative Budget .....	73
<b>Title: Integrated R4D approach: Lessons from the field for Sustainable Intensification and Role of effective partnerships. ....</b>	<b>74</b>
Theme.....	74
Activities Addressed .....	74
Justification .....	74
Research Methods.....	75
Deliverables.....	75
Research Outcomes.....	75
Partners and Indicative Budget .....	75



<b>Title: Assessing optimal irrigation technologies and practices using a farm system approach .....</b>	<b>76</b>
Theme.....	76
Activities Addressed .....	76
Justification .....	76
Research Methods.....	77
Deliverables (July 2015-December 2016).....	78
Research Outcomes.....	78
Partners and Indicative Budget .....	79
<b>Title: Supplementary furrow irrigation of high value crops using Tractor mounted motorized pumps.....</b>	<b>80</b>
Theme.....	80
Activities Addressed .....	80
Justification .....	80
Research Methods.....	81
Deliverables .....	82
Research Outcomes.....	82
Partners and Indicative Budget .....	82
<b>Title: Enhancing the productivity of onset system through Integrated Disease and Pest Management (IPM) approaches .....</b>	<b>83</b>
Theme.....	83
Activities Addressed .....	83
Justification .....	83
Research Methods.....	84
Deliverables .....	85
Research Outcomes.....	85
Partners and Indicative Budget .....	85

## Title: Diagnosis and characterization of the most important constraints that hinder women and marginalized groups from achieving full productivity potential and income generation

ILRI

### Theme

Theme 6: Cross Cutting Problems and Opportunities.

### Activities Addressed

4.1.1 Diagnose and characterize the most important constraints that hinder women and marginalized groups from achieving full potential productivity and income generation

4.1.2 Identify constraints that hinder women's participation in research for development interventions using PRA tools and survey

4.1.2 Transform household gender relations using the Transformative Household Methodology (THM)

### Justification

The status and role of men and women in all aspects of mixed farming systems differ markedly across agro-ecological areas and Africa RISING' action sites. A systematic literature review will provide a basis for understanding the key constraints that prevent women and other marginalized groups from investing in intensification and actively participate in project activities (including technology development, information sharing, meetings and trainings among others). This will provide a basis for testing and evaluating different approaches for increasing women's participation in and benefit from research for development interventions.

Culture and norms play a key role is influencing women's participation in and benefit from research and extension activities. Women's level of participation in decision making processes is also extremely low. Transformation of gender constraining norms is a pre-requisite to get more women participate in decision making processes, research and extension activities and gain more access to and control over resources. The Transformative Household Methodology is a tool that creates awareness of intra-household gender relations between men, women, girls and boys, transforms the gender stereotypes and empower women.

### Research Methods

- Systematic literature review of the most important constraints that hinder women and marginalized groups from investing in sustainable intensification practices.
- Validation of gendered constraints with IP members at Woreda and Kebele level through workshops

- Conduct group discussions (with men, women and youth) and in-depth interviews (with key informants) to establish the factors that hinder investment in sustainable intensification practices and participation of women in research for development interventions.
- Transformative Household Methodology to create awareness and promote improved intra-household relationships among small holder farmer families. Experts from Send a Cow, an NGO, will facilitate the activity. The Women in Agriculture Empowerment Index will be used to measure women's empowerment before and after the intervention

## Deliverables

Deliverable	Date due
Literature review characterizing gendered constraints to agricultural intensification and drivers of intensification in rural Ethiopia	Sept. 2015
Reports from validation workshops	Dec. 2015
Manuscript on factors that enhance or hinder women's participation in research and extension activities	Apr. 2016
Gender transformative strategy report using the Transformative Household methodology - including key results	June 2016
Report on women's empowerment levels using the Feed the Future Indicators	June 2016

## Research Outcome

Gender-related constraints to intensification will be established which will be used to prioritize interventions and target appropriate technology clients. Research planning and implementation will incorporate information on constraints, needs and opportunities for gender-responsive innovation. Identification of social, economic and cultural barriers that prevent women and other marginalized groups from actively participating in various project activities. Structures and approaches that facilitate intensification, equal participation of men and women and more equitable benefit sharing will be established using gendered constraints and opportunities. Using the THM, there will be transformation of intra-household relationships among smallholder farmer families, increase in women's empowerment, and their participation in agricultural research and extension activities.

## Partners and Indicative Budget

Organization	Key contact	Indicative Budgets (USD)	
		Staff	Operational
ILRI	Annet Mulema (4 d/m) supported), Elias Damtew (2 d/m)	33,000	20,000
IWMI	Valentine Ghandi (1 d/m)	4,000	
Send a Cow	Nigist Shiferaw (2 d/m)	3,000	
Total		40,000	30,000



## Title: Stepwise Intensification Options for Small-scale Faba Bean / Forage Production Systems.

ILRI

### Theme

Theme 2: Field Crop Varietal Selection and Management

### Activities Addressed

2.2.1. Review and evaluate incompatibilities between existing and improved management practices required for optimum production from improved varieties.

2.2.2. Trade-off analysis to evaluate the feasibility of improved management practices.

2.2.3. Participatory evaluation of improved management practices in conjunction with new varieties.

2.3.1. Review options for intercropping key crops (including forages) at Africa RISING sites.

### Justification

The demonstration activities with faba beans undertaken at the Africa RISING research sites during the Meher season of 2013 highlighted the differences between farmers' existing practices and those required for the successful adoption of improved bean variety / management packages. Most significantly, we have observed farmers in SNNPR and Amhara regions weeding their bean crops very late leaving volunteer wild oats, other grass weeds and *Trifolium* sp. to create an ad hoc forage – bean intercrop. As a source of forage, these “weeds” are significant. A preliminary study conducted at Lemo has indicated that up to 2 tonnes (average: 1.4 tonnes) of wild oat forage dry matter may be made available within a growing season. Moreover, the establishment costs for the forage component are, effectively, zero making this a very cost effective source of what is actually quite high quality forage. This protocol proposes a systematic exploration of a set of possible intensification trajectories for the forage – bean intercrop. This needs to include the identification of (1) competition-tolerant bean varieties that can recover after the forage crop is removed under farmers' existing practice, (2) the possibility of identifying alternative forages to increase productivity whilst retaining the cost benefits of the volunteer-based forage crop and (3) options for stepwise intensification towards specialized bean production for those farmers who begin to appreciate the benefits of market participation.

### Research Methods

This research will adopt a stepwise, participatory approach, over two successive Meher seasons, to evaluating the following intensification trajectories:

1. Introduction of bean varieties with traits more suited to existing farmers practice (competition tolerance, possibly longer duration to allow recovery, focus on residue quality to improve overall forage quality and quantity from forage – bean intercrops);
2. Establishment of a more formal forage – bean intercropping system based on improved forages and bean varieties with complimentary traits;
3. Introduction of improved variety / management practices for monocropped beans either de novo or as a follow-on from trajectories 1 and 2.

The research has two components:

The farmer research groups who have been formed and participated in the faba bean forage intercropping research in the 2014 meher season will be engaged for the main rainy (meher) season experiment in 2015. Out of five faba bean varieties being tested with irrigation for competition tolerance, three will be selected based on their preliminary performance record. The selected faba bean varieties will be tested by farmers under three management conditions (traditional (native forage weeds allowed to grow with the bean until a stage when farmers harvest for livestock feed), improved management (bean plots are weeded properly at recommended level or not allowing forage weeds to grow with the beans) and faba bean intercropped with improved oat variety). MSc student will be identified from the local universities to be attached to this experiment

The replicated competitive faba bean variety selection trial which is currently being done by irrigation will be repeated in the main rainy season with all the five varieties to compare the results of irrigated and rain-fed performances with regard to competition tolerance with limited number of farmers. The current MSc student will continue to be attached with this work. The research team will provide technical support for the establishment of the trial plots on each farm and the monitoring of overall performance.

#### **Data/Measurements:**

- Soil samples before and after the intervention will be taken from representative sample farms to assess impact of intervention on soil nutrient level
- Dates of sowing, weeding (where applicable), flowering, maturity, harvest
- Participatory Plant performance assessment during the vegetative stage (bean and forage) will be made jointly with farmers, extension staff and researchers
- Agronomic measurements (plant height, tillering, biomass & quality, disease/pest incidence
- Socio economic data (labor, gender, cultural and livelihood implications) of the intervention will be collected
- Qualitative assessment by farmers of the impact of the intervention (treatments) on livestock performance will be made
- System level analysis of benefits and trade-offs of alternative faba bean production practices will be conducted taking into account effects on soil nutrient status, grain yields, livestock performance and financial benefits obtained by farmers.

#### **Deliverables**

Deliverable	Date due
-------------	----------

Options for intensifying faba bean / forage production systems to be tested by farmers during the Meher season of 2015.	June 2015
Physical and financial evaluation of the technical options implemented on farms during Meher 2015 and a comprehensive assessment of likely trade-offs.	November 2015
Interim review of project findings with the wider community and assessment of scaling potential and possible approaches.	March 2016
Revised set of options for faba bean forage intercropping	May 2016
Final physical and financial evaluation of the technical options across both seasons and completed trade-off analysis.	November 2016

## Research Outcomes

This research will lead to a clear view of the relative benefits of a range of options for intensification of a sub-system that generates food, forage and cash income for farmers. These options will differ in the extent to which farmers need to make an initial commitment to intensification; from interventions that require minimal changes in management practices (other than a change of variety) and are, therefore, more likely to be adoptable in the short term to interventions that require significant change of practice but have the potential to generate a greater overall returns. Farmers participating in the research will provide an evidence base that the concept of flexible intensification trajectories and including a robust trade off analysis will constitute sound basis for future scaling of the innovations within and beyond Africa RISING research sites.

## Partners and Indicative Budget

Organisation	Key contact	Indicative Budgets (USD)	
		Staff	Operational
ILRI	Aberra Adie (supported by Peter Thorne, Kindu Mekonnen, Alan Duncan and Melkamu Derseh)	Kindu/Peter: Please propose budget based on your knowledge of fund status	
ICARDA	Seid Ahmed Kemal (supported by Girma Tesfahun )		
Local partners (in Debre Birhan and Hosanna)	TBA		



## Title: Assessing importance of animal health constraints in mixed crop-livestock systems and farmers' understanding of infectious diseases.

ILRI

### Theme

7. Knowledge Management, Exchange and Capacity Development

### Activities Addressed

- 3.1.1. Review AKT5 knowledge bases to identify opportunities for knowledge strengthening.
- 3.1.2. Design knowledge transfer processes and media to target these opportunities (via CHEGs)

### Justifications

There are many infectious diseases affecting livestock in Ethiopia resulting in overall poor productivity and unnecessary losses. These diseases may also mask the true impact of other interventions, such as for example improved feeds or breeding programs. Provision of veterinary services is in general very limited and national vaccination programmes are patchy. In addition, farmers seem to have a poor understanding of infectious diseases and livestock losses are being accepted as fate with very little done to prevent them.

These issues are common across Ethiopia, and therefore activities proposed here will be implemented in close coordination with research activities conducted under the CRP Livestock and Fish.

### Research Methods

A participatory epidemiological survey will be conducted in the Africa RISING sites in Ethiopia. In each kebele two focus group meetings will be organised simultaneously, one for men and one for women. In each FG, key constraints for livestock production and livestock diseases will be identified and ranked. Detailed descriptions and incidence of the health problems will be recorded. Participants will then be asked to outline transmission of the 2 most important diseases and for each transmission step, clarify who within a household is involved in a particular risk activity. The FG meetings will be facilitated by local veterinarians and extension works who will receive a one-week training in participatory epidemiology beforehand.

Based on the findings of the survey, sero-surveys will be planned to confirm initial findings. Furthermore, targeted disease information for farmers will be developed and distributed during the sero-survey. The objective of this material is to give information on how to recognize a disease, how it is transmitted, what actions should be taken if a disease is suspected and how a disease can be prevented. In addition, a disease

recognition tool for farmers will be developed which allows them to monitor health in their herds while at the same time improving their understanding on infectious diseases.

## Deliverables

Deliverable	Date due
Training in participatory epidemiology for 8 local vets/livestock extension workers	30.6.2015
Focus group meetings in all sites	31.7.2015
8 trainees attend dissemination workshop for PE results and training on disease extension material	30.9.2015
Developing disease info and monitoring material	30.9.2015
Sero-survey training and planning conducted	31.10.2015
Field work to collect sero-samples completed	30.11.2015
Analysis of samples for 2-4 diseases completed	31.1.2016

## Partners and Indicative Budget

Organisation	Key contact	Indicative Budgets (USD)	
		Staff	Operational
ILRI	Barbara Wieland	10'000	Info material 6'000, PE training 8'000, PE field work 6'000, workshop attendance 6'000, sero-survey field work 8'000, laboratory costs 16'000
ICARDA	Barbara Rischkovsky	5'000	



## Title: Factors governing the use of improved forage and forage seed at smallholder level in the Ethiopian highlands

ILRI

### Theme

1: Feed and Forage Development

4: Improved Land and Water Management for Sustainability

### Activities Addressed

2.1.1. Overall assessment of existing use of forage and forage seed at smallholder level

2.1.2. Assessment of factors governing the use of improved forage and forage seed

2.1.3. Identification of the gap between demand and supply of forage seed

### Justification

Extensive research has been carried out to test and evaluate the adaptability and performance of forage species under different agro-ecological zones. Many indigenous forage species have low productivity, which reduces their usefulness for livestock nutrition. Utilizing improved forage seed helps produce good quality forage that can be fed to livestock for better productivity. Adaptation of improved forage also complements production of other crops through maintaining soil fertility in addition to mitigating soil erosion. It is proposed to investigate the following for the better adaptation of improved forage and forage seeds at smallholder level:

- Factors motivating/de-motivating smallholder farmers from producing/not producing improved forage seed and forage
- Identifying few critical barriers to the adaptation of improved forage seed at smallholder level
- The status of production, distribution and marketing of improved forage and forage seed
- Based on the above investigation, there will be recommendations for creating sustainable system to increase forage and forage seed adaptability at smallholder production systems.

### Research Methods

The combination of quantitative and qualitative research methods shall be utilized. The research methodologies include:

- Review of related secondary data from farmers
- Use of questionnaires to collect qualitative and quantitative data
- Focus group discussions with key informants, farmer groups and intervention platform members

- Sampling: an appropriate sampling technique will be used
- Adoption econometric models which best suit to the underlined study will be applied.

## Research outcomes

The outcomes of this study will be clear identification of factors hindering and promoting the effective use of improved forage and forage seed by smallholder farmers as well as other value adding agri-businesses (such as dairy cattle and shoats fattening and poultry) in the research areas of Africa Rising. The different factors related to the effective use of improved forage seed will be checked for causal relationship. Finally, research conclusions and recommendations will be shared with all stakeholders as per the research findings for better use of improved forage seeds in the predetermined research areas and beyond.

## Deliverables

Deliverable	Date due
Methodology and survey instrument	May 30, 2015
Field study	June 1 – Aug 31, 2015
Analysis and report / publication on full field study	Dec 31, 2015

## Partners and Indicative Budget

Organisation	Key contact	Indicative Budgets (USD)	
		Staff	Operational
Africa Rising			US\$30,000
ILRI/FeedSeed Project	Dr Barry Shapiro		



## Title: Identifying sustainable forage seed production and marketing models for Ethiopia

ILRI

### Theme

1: Feed and Forage Development

### Activities Addressed

- 2.1.1. Evaluation of seed production and marketing models: smallholder farmers, private seed companies, public (parastatal) seed companies and farmer cooperatives
- 2.1.2. Assessment of factors governing the choice of best forage seed multiplication approach
- 2.1.3. Assessment of factors governing the choice of best forage seed marketing approach

### Justification

Utilizing improved forage seed helps produce good quality forage for better livestock productivity. An increase in forage supply presupposes the availability of more forage seeds. It is estimated that Ethiopia will need about 8.9 thousand tons of annual and perennial forage seeds by the year 2020 and the current seed quantity within the country is estimated to be only 2.2 thousand tons (LMP, 2015). There is a need to increase the seed supply by at least 300% in order to support the expected growth in the number of livestock. The existing forage seed system is underdeveloped due to lack of technical and business expertise in seed production, processing and marketing. The seed supply system is also weak because of the lack of effective extension focusing on forage development and livestock production in general. The existing forage seed market is very much dispersed with weak linkages between suppliers and buyers and a general lack of market information prevails.

In October 2014, ILRI launched the FeedSeed project in order to contribute the development of sustainable forage seed system in Ethiopia. The project used four approaches (models) in order to develop a successful forage seed production and marketing system. The FeedSeed project provided the necessary technical and business training to selected farmers, farmer cooperatives, private and public sector enterprises which are now producing and selling different varieties of forage seed. It is now time to investigate which of these models is performing well and why under the Ethiopian context.

The outcome of this investigation is expected to contribute to the body of knowledge in the scientific community and, most importantly, provides the basis for identifying the best approach(s) to increase the supply of forage seed and create sustainable market system. The main objective of this research protocol is to investigate the following:





- Based on the FeedSeed experience, which production and marketing approach(s) should be adopted to create sustainable forage seed system
- Identifying most critical factors that help develop effective and sustainable forage seed systems
- Provide recommendations for scaling-out of the most promising approaches over the short and long-term time frame
- Identifying critical barriers and opportunities to the adaptation of selected forage seed model(s).

## Research Methods

A combination of quantitative and qualitative research methods shall be utilised. The research methodologies include:

- Review of related secondary data and literature
- Use of questionnaire to collect qualitative and quantitative data from actors and stakeholders
- Focus group discussion with key informants, farmer groups and intervention platform members
- Sampling: an appropriate sampling technique will be used.

## Research outcomes

The anticipated outcome of this research will be:

- Identification of the pros and cons of each forage seed multiplication and marketing model
- A clear identification of best forage seed multiplication and marketing models and identify the Ethiopian conditions under which each is appropriate.

## Deliverables

Deliverable	Date due
Methodology and survey instrument	May 30, 2015
Field study, including data collection	June 1- July 30, 2015
Analysis and report / publication on full field study	December 31, 2015

## Partners and Indicative Budget

Organisation	Key contact	Indicative Budgets (USD)	
		Staff	Operational
Africa Rising			US\$20,000
ILRI/FeedSeed Project	Dr Barry Shapiro		

## Title: Participatory evaluation of techniques to improve the utilization of crop residues by farm households

ILRI

### Theme

Feed and Forage Development

### Activities Addressed

Implement on-farm evaluations of improved crop residue utilization techniques

### Justification

In the mixed crop-livestock farming systems of Ethiopian highlands, crop residues (CR) constitute an important part of livestock feed, particularly in the dry period when green forage is scarce. In most cases CR are stored as heaps in the open air and feeding takes place by spreading a portion on the ground. These traditional management practices appear to result in considerable loss of CR biomass and quality as a result of weather, pests, contamination and prolonged storage. It is believed that adoption of improved methods of storage and feeding practices will minimize wastage, improve feeding values and contribute towards alleviating dry season feed shortages. It is also hypothesized that farmers with better livestock market orientations can readily adopt improved CR utilization for increased livestock productivity. Participatory action research and laboratory testing is therefore required to document local practices and CR nutritive value and test if adoption of improved techniques by farmers can:

- minimize quality deterioration/wastage during storage
- minimize CR refusal during feeding
- increase the feeding value of the CR through supplementation

Improving the efficiency with which the available farmland biomass is used as an animal feed appears the first step towards solving critical feed shortage. If farmers adopt least-cost techniques that improve the quality and utilization of CR, it will increase their farm/livestock productivity. Moreover, documenting the relationships between livestock market access/orientation of farmers and their CR management and readiness to adopt new techniques will provide valuable input for future technology interventions.

### Research Methods

- Farmer groups formed last year in the eight Africa RISING kebeles will be used to continue the research.
- The performance of improved Postharvest handling and utilization techniques which have been put in place within the farmers' research groups will continue to be monitored regularly.

- The quality of the CR stored under different conditions and the level of wastage associated with storage and utilization techniques will be measured
- Participatory evaluation of the technologies will be conducted by inviting both participant and non-participant farmers
- Feasible technologies that will be scaled within and beyond the research kebeles will be identified
- Sequential analysis of samples of local CR heaps to reinforce the result obtained from Basona Worena site
- Continuing in Sinana: Development of feeding strategies using predominant crop residues; current is faba bean, to continue with tree Lucerne, chickpea, field pea, lentil for the subsequent 12 months

## Deliverables

Deliverable	Date due
Mid-term report on the performance of tested postharvest handling techniques	July, 2015
Final Report on the performance of tested postharvest handling techniques	Dec, 2015
Report on nutritive value and mycotoxin status/contamination analysis of stored CR	Feb 30th, 2016,
Report on participatory farmers' evaluation of the interventions (through field days)	SSept,015
Report on development of supplementation packages to improve the nutritive value of CR from pulses	November, 2016
Final report and publications (2 journal articles)	March 15th, 2016

## Research Outcomes

The expected outcome of this research is that farmers in the research sites will be acquainted with and adopt new technologies that minimize wastage of crop residues during storage and feeding, while at the same time improving the palatability and the feeding value of the residue. The techniques will help farmers to effectively utilize the available crop residue biomass and increase their farm productivity. During the evaluation process, forums will be created where farmers within and outside the group will share knowledge and experiences on how to further improve the handling and utilization of crop residues and scale better practices.

## Partners and Indicative Budget

Organisation	Key contact	Indicative Budgets (USD)	
		Staff	Operational
ILRI	Melkamu Bezabih (7d/m), Aberra Adie (5d/m) Alan Duncan (2d/m), Kindu Mekonnen (5d/m), , Peter Thorne (1d/m) (1d/m)		30,000
ICARDA	Jane Wamatu (10 days/month), Barbara Rischkowsky (11 days/annum)	75,000	
Site teams	Dawit Abate (Sinana ARC) and other team members		



## Title: Supplemental fodder production to improve livestock productivity in the Africa RISING sites

ILRI

### Theme

Feed and forage development

### Activities Addressed

On farm evaluations of promising feed and forage combinations for different productions systems.

Design and test forage production systems under irrigation that can complement the existing feed resource base.

Evaluate water use trade-offs against other options for irrigable land.

### Justification

Feed shortage associated with high seasonal fluctuation in the quantity and quality of available feeds has become a major constraint for livestock production in the Ethiopian highlands. The problem is triggered by the continual conversion of grazing lands to arable lands, forcing livestock to heavily depend on low quality crop residues for their nutrition. Addressing the problem of feed shortage and quality is essential as livestock serve as an important source of livelihood for smallholder farmers (farm power, cash income, animal protein and manure) with a high potential to drive intensification of the mixed farming system. One of the approaches to address the problem of feed shortage is to test and adopt innovative way of improved fodder production that can serve as a supplement to the poor-quality basal diet of crop residues. This involves production of annual/perennial fodder using supplemental irrigation, use of high yielding annual oat-vetch fodder, use of dual or multipurpose crops/fodder and conserving excess feed produced during the main growing seasons for use during the dry periods. Moreover, linking the improved fodder production with livestock feeding for marketable products is important to encourage farmers to adopt the fodder technologies. From the pilot fodder intervention trials in the AR sites in 2014, it was observed that the interest of farmers on the choice of animals for intensive feeding differs from individual to individual and from site to site. Supporting farmers according to their interest and analyzing trade-offs in using the available land, water and feed resource for different livestock products and services appear very important at the moment.

## Research Methods

Farmer groups who have been formed to participate in the improved fodder production protocol will be the target of the action research in all the AR kebeles. Based on the inventory made during the 2014 season trials regarding the choice of fodder crops (annual-oat/vetch, and perennial-Napier-desho grasses), planting season (rain-fed/supplemental irrigation) and type of livestock product (milk, meat or traction), the farmers will be clustered according to their interests and capacities. Additional trainings will be given on land preparation, planting of fodder crops, management of irrigated fodder crops and utilization for different species of animals. Planting will take place on larger plots so that it will be possible to assess the impact of the fodder intervention in improving the livelihood of farmers. The farmers will also be trained on how to regenerate their own planting materials to sustain their own seed system for the next round of planting. Biomass yield, quality and relevant agronomic data will be collected. A student will be attached to the research protocol who will assess the impact of the fodder intervention on the productivity of livestock and hence the income of farmers using the method developed for this purpose. The water productivity of using irrigation for fodder production will also be assessed.

## Deliverables

Deliverable	Date due
Report on the planting of fodder with supplemental irrigation where irrigable water is available (Lemo, Endamohoni, and Sinana)	May, 2015
Report on the planting of rain-fed fodder in all AR sites	July, 2015
Report on mid-term field day evaluation of irrigated and rain-fed fodder	August, 2015
Report on the yield performance of irrigated and rain-fed fodder	Nov, 2015
Preliminary report on the impact assessment of the fodder intervention	Jan, 2016
Comprehensive report on the impact assessment and future direction for scaling	March, 2016
Publication of major findings (journal article)	June, 2016

## Research Outcomes

Income diversification and increased integration of crop-livestock systems is important to improve the livelihood of smallholder farmers. This project will enable to explore the available opportunities for farmers with regard to improved fodder production to supplement the locally available feeds. The action research is expected to improve the feed resource base of farmers and hence improve their livestock productivity. The project will also enable to establish the feasibility of irrigated fodder production during the dry period to diversify the income of farmers, and its contribution to further integrate mixed crop-livestock systems. Farmers will get opportunities to acquaint themselves with improved techniques of feeding livestock targeting specific market niches and share experiences on how to effectively utilize locally available feed resources.



## Partners and Indicative Budget

Organisation	Key contact	Indicative Budgets (USD)	
		Staff	Operational
ILRI	Melkamu Bezabih (5d/m), Aberra Adie (5d/m), Alan Duncan, Peter Thorne, Kindu Mekonnen, Annet Mulema		20, 000
IWMI	Valentine Gandhi, Petra Schmitter		



## Title: Design and test processes to foster learning and identify knowledge pathways to disseminate agricultural innovations in Africa RISING sites

ILRI

### Theme

7: Knowledge Management, Exchange and Capacity Development.

### Activities Addressed

5.1. What linkages and processes need to be strengthened or established to enable actors to work more efficiently / effectively together?

### Justification

Africa RISING participating farmers have been organized as an innovation cluster/farmers research groups and linked to the kebele level operational and woreda level strategic innovation platforms. The innovation platform approach is set and used in Africa RISING project to realize the research for development activities. The main focus of the project to adopt the innovation system in agriculture is to create strong partnership and better engage communities to test and demonstrate technologies that works best in system integration and can be scaled up widely. Last year a number of research activities have been done to set up and connect platform networks and develop capacity of members to innovate. Now there is a clear structure for the platform networks and how it operates at three level (woreda, kebele and community). There is still a need to continue supporting each platforms to effectively operate in addressing the local specific institutional, technological and social issues through designing and testing facilitation, communication and coordination processes. These activities include supporting of the core innovation platform team called “Technical Group” members to foster learning between platform members through organizing different events including farmers’ field days, exchange visits, training and learning forums using digital tools (In collaboration with Digital Green organization). They will be also supported to design and implement their own research activities that will complement the ongoing research activities by CG centres and scaling up works to reach more farmers. There is also a need for clear and practical guideline on how these platforms better connected to the existing higher-level networks to enable them to contribute to the wider national policy issues.

Another research activity will focus on designing and testing of protocols to document knowledge pathways to disseminate agricultural innovation. These include identifying and adapting of data collection and analysis tools for documenting knowledge pathways for disseminating innovation using multi-stakeholder processes being used by international research organizations in different countries. This work will be done in collaboration with Wageningen University and/or Humidtropics social scientists to identify and test data collection and analysis tools that have been used in different countries.



## Research Methods

Africa RISING researchers involved in these activities will support technical group members of each platform to identify and use communication tools that foster learning among members (Digital tools). The documentation and sharing of each innovation platform activities will be done to capture the process and content of the learning taking place per site. This time each platform will be supported to prioritize and implement their own action research activities and scaling up works that will complement the existing research works. These research activity will also identify strong networks found in each region and or national level to link each strategic IPs for experience sharing that can address policy issues at regional and national level. There will also be a work with social scientists working for international organizations for joint development and testing of protocols used to collect and analyze data to measure effectiveness of Africa RISING Ethiopia IPs. These work will enable us to document our experiences of IPs and its contribution to the innovation system in agriculture that can be shared globally. Review and improvement of the documents done so far including the guidelines developed is also another activity.

## Deliverables

Deliverable	Date due
Capacitate and equip communication champions to test and use communication tools that fits the local context	Nov 2015
Guideline to link strategic innovation platforms with existing higher-level networks	Aug 2015
Protocol for data collection and analysis to document knowledge pathways to disseminate agricultural innovation	Sep 2015
Data collection and analysis	Mar 2016
Draft paper on knowledge pathways to disseminate agricultural innovation in Africa RISING sites.	May 2016
Innovation platform members' action-research activity report per site	Jan 2016
Processes documentation of innovation platform activities (P meeting reports, farmers field days reports, blogposts, photo reports and video clips)	Regularly in 2015 /2016

## Research Outcomes

The research outcomes include identification and use of specific communication tools including digital ones for IPs at different levels that aims to better engage community in knowledge creation, dissemination and use. As the innovation platforms continue operating per site they will be linked to higher level networks to enable them share best experiences that focus on policy and institutional issues. Innovation platform members will be facilitated to play their role in prioritizing and implementing of their own action research and scaling up works. A draft research paper on knowledge pathways to disseminate agricultural innovation will be developed. Continuous documentation and sharing of innovation platform activities

through different communication channels including website, wiki, youtube, flicker and hard copies will be made available for different audiences.

## Partners and Indicative Budget

Organisation	Key contact	Indicative Budgets (USD)	
		Staff	Operational
ILRI	Zelalem Lema	90%	<b>Staff time budget: Total = _____</b> Detail: Zelalem: 110 USD/day*198 days= 21,780 USD Alan: _____USD/day*11 days = _____USD Ewen : 600USD/day*22days= 13,200 USD Simret : 72 USD/day*11days= 792 USD Marc: _____USD*22 days = _____USD Digital: contract I think?? <b>Operational Cost: 38,000</b> Field travel costs: 18,000 USD Training cost: 20,000 USD
ILRI	Alan Duncan	5%	
ILRI	Simret Yasabu	5%	
ILRI	Ewen Le Borgne	10%	
IITA	Marc Schut	10%	
Digital Green Org	???	??	

## Title: Integrating tree lucerne (*Chamaetysius palmensis*) in the crop-livestock farming systems of the Ethiopian highlands for multiple products and services

ILRI

### Theme

Theme 5: Improving the Efficiency of Mixed Farming Systems through more Productive Crop - Livestock Integration

### Activities Addressed

- 3.1.1. Identify niche options for tree (e.g. fodder, fertility management, fuel, construction etc) and species (including indigenous species) with the potential to fill these.
- 3.1.2. On-farm testing and evaluation of promising tree species.
- 3.1.3 Identify quality seed and seedling supply systems

### Justification

Shortage of animal feed, soil fertility depletion, lack of wood for various products and low income for small holder farmers are, among others, critical challenges in the Africa RISING (AR) research sites of the Ethiopian highlands (PCA report, 2013). Identification of different options that enhance crop and livestock productivity as well as diversify income sources are priorities for Africa RISING project. Integration of multipurpose trees such as tree lucerne (*Chamaecytisus palmensis*) in the crop-livestock farming system can be one potential option to support fodder availability, improve soil fertility and enhance crop-livestock productivity. Tree lucerne is a nitrogen fixing species (100 kg N ha<sup>-1</sup>) and adaptable for use in highland areas (2000-3000 masl). It has potential for use as livestock fodder (leaves with 20-30 % protein and 77-82 % IVDMD), fencing and housing as a component of livestock value chains. The plant also has potential for use as fertiliser, biological soil conservation, wind break and fencing as a component of crop value chains. Some farmers in AR sites such as Basona Kebele have already started selling tree lucerne seeds to generate additional income. However, women have limited access to fodder which constrains investment in livestock as well as sustainable agricultural intensification. The integration of tree lucerne to the crop-livestock farming system could save labour and time spent to look for fodder and fuel. The intervention could be an incentive to women and marginalized groups to invest in mixed farming systems.

## Research Methods

Farmer groups who have interest in tree lucerne farming and that can allocate land will be identified through community consultation (with men, women and youth) in the eight Africa RISING research kebeles. Potential community/government nursery sites will be identified, and new ones established to produce tree lucerne seedlings. Institutional structures and rules such as byelaws will be formulated for managing and utilizing trees/nurseries to ensure that both men and women benefit equitably. The planting area that each farmer allocates will be visited and evaluated for its suitability to grow trees and obtain the expected benefits. Training will be conducted for farmers and extension agents to be knowledgeable on nursery establishment and management, out-planting, tree management and utilization. An experience sharing/ exchange visit will be organized for farmers to areas where there are successes in tree lucerne based farming. Field days will be also organized to share lessons of participating farmers to other nonparticipating farmers. The training and experience sharing activities will enable farmers to develop more interest and manage tree lucerne in their farms. Farmers' observations, benefits, challenges and opportunities while growing, managing and utilizing tree lucerne will be documented.

Before the introduction of the tree lucerne, gender analysis will be conducted to establish the gender dimensions around the enterprise, and explore who has access to resources, who controls resources, what are the gender roles around management of tree lucerne, who has access to the products, who makes decision over the products and utilization, how benefits are shared, what is the current level of knowledge, technologies used, institutional factors e.g. tenure system.

Tree lucerne growth and biomass will be measured periodically. The harvesting frequency of tree lucerne that results in the highest biomass yield and nutritive quality of the leaves will be documented for future site-specific recommendations. Soil samples will be collected and analyzed for major nutrients based on tree lucerne growing niches and tree lucerne farming objectives. On farm evaluation will be conducted to document the contribution of tree lucerne leaves supplementation to crop residue basal diets and physical processing (chopping) on the feed intake and performance of animals. Trade-off analysis will be carried out for various competing uses of tree Lucerne.

## Deliverables

Deliverable	Date due
Formation of eight farmer interest groups on tree lucerne farming	May 2014
List of potential niches for tree lucerne farming	Jun 2014
Training of 160-200 farmers (20-25 farmers per kebele) on tree lucerne farming	Jun-Sept 2014
One experience sharing visit for 40-50 farmers (4-5 farmers per kebele)	Oct-Dec 2014
A field-day to share lessons of participating farmers to other farmers	Nov-Dec 2015
Report on the process of farmers engagement and their feedback	Dec 2015
Gender analysis report	Dec 2015
Development of feeding strategies based on supplementation using tree lucerne fodder for Basona site	Dec 2015
Two MSc thesis	June 2016

Deliverable	Date due
Ration packages for farmers using tree lucerne foliage in Basona site	August 2015
A brief manual on how to plant, manage and utilize tree lucerne	Sept 2016
Report on growth and biomass of tree lucerne	Sept 2016
At least one journal article will be produced	Sept 2016

## Research Outcomes

Research, extension and nongovernmental organizations have been trying to promote planting of multipurpose trees like tree lucerne in the highlands of Ethiopia. However, the success has not been as expected due to lack of approaches that consider farmers needs and realities. The participatory and targeted research approach and the training and experience sharing schemes from the current project will enable farmers to grow more tree lucerne plants and improve the availability of biomass for supplementary feed, soil fertility improvement and other products and services. The synthesis that we intend to write from the research approach can serve as a guide for the extension to promote growing of more multipurpose trees, covering more areas within and beyond the Africa RISING research sites and benefits more farmers. We expect increased women's access to and control of fodder and biomass, and labour saving. Feed and forage combinations that are appropriate for men and women in different agro-ecological zones will also be available. Gender analysis will help us understand the areas to focus on so as to integrate men and women's issue, directly address them and also gauge who will benefit and how gender relations within the household will change.

## Partners and Indicative Budget

Organisation	Key contact	Indicative Budgets (USD)	
		Staff	Operational
ILRI	Kindu Mekonnen, Melkamu Bezabih, Peter Thorne, Annet Mulema, Aberra Adie,		Jane= 13000 Others= 50000  Total=63,000
ICRAF	Aster -1.5 d/m)	9450	
ICARDA	Jane Wamatu (for a total of 24 days)	13693	
CIP	Jogo Wellington (1.5 d/m)	8000	
	Total	31143	

## Title: Enhancing and monitoring impacts of complementary and linked land and water management technologies and approaches at landscape/ watershed levels

CIAT

### Theme

Theme 4: Improved Land and Water Management for Sustainability

### Activities Addressed

- 1.1.1 Inventory of factors affecting access to water resources by differentiated stakeholder groups
- 1.2.1. Develop and implement water access plans mediated via Kebele and Woreda level IPs
- 1.2.2. Document recommendations for scaling based on outcomes
- 2.1.1. Identify and document water management options that could help derive sustainable intensification
- 2.1.2. Identify and test (at household or wide scales) appropriate and sustainable water management solutions to address those niches (linked to activities of themes 1-3)

### Justification

Sustainable intensification of small-scale farming systems demand an integrated strategy that would connect components across scales, target socio-ecological niches, minimize trade-offs and maximize returns per unit of investment. In our protocol entitled “Enhancing food security and environmental stability through landscape based integrated water and land management”, we have achieved impressive results specifically forming partnership with district and community level institutions, developing capacity of key stakeholders including local farmers and guiding implementation of sustainable land and water management options in two sites of two AR Kebeles (Basona and Lemo). Based on the training and experience sharing scheme of AR, improved land and water management technologies have been introduced. Special mention can be made of the 20 smallholder farmers at Lemo who have developed shallow groundwater wells of up to 15 meters deep inspired by the training and exchange visit that AR project organized for farmers, researchers and local level decision makers. In two of the AR sites, different types of soil and water conservation activities have also been carried out by the communities and local administrative bodies with technical support of AR project. In addition, participatory landscape characterization and discharge, sediment and erosion monitoring were conducted for ‘treated (conserved)’ and non-treated (non-conserved)’ sites at plot and landscape levels. Results show that about 45% of the water from conserved areas has been retained within the watershed for subsequent base flow.

Suspended sediment yield of the non-treated watershed was about three fold more than that of treated watershed. In addition, non-treated plots have experienced 50% more soil loss compared to treated ones. These results indicate that with improved SLM across the landscape, soil erosion can be reduced, land productivity can be improved, and more water can be retained for subsequent use (drinking, irrigation etc.) within the watershed. Our first-year experience showed that capacity building of local actors, closer partnership with regional and local government as well as non-government bodies, monitoring of costs and benefit are critical components for sustainable and integrated land and water management. The aim of this protocol is thus to capitalize on our partnership and initial investment and focus on introduction and out/up-scaling of targeted, complementary/linked land and water management technologies and approaches considering socio-ecological conditions, develop capacity of locals on land and water management options and monitor the positive and negative impacts of interventions at farm and landscape scales. Since the interventions have shown signs of increasing water availability within watersheds emphasis will be given to improved irrigation water management. The productivity, profitability and sustainability of the various options will be assessed based on integrated hydrological and agronomic models.

## Research Methods

This protocol will focus on the “AR Climate-Smart Landscapes” (continue integration and monitoring) and others for out-scaling. Implementation of this protocol will continue on the two AR Woredas (Debre Birhan and Lemo). Representative landscapes will be selected from the existing bigger watersheds in the two woredas for demonstration and actual implementation of various interventions. Participatory approaches with appropriate technologies and governance structure and linkages have demonstrated success in implementing SLM technologies. Learning from the previous implementation, the project envisions to continue engaging Woreda-Kebele level administration, extension agents, universities, researchers, non-governmental organizations and importantly the community to implement integrated water and land management measures. Community awareness creation and mobilization will continue to inform stakeholders about complementary and linked technologies. Complementary and linked technologies are those where implementation of one facilitates the implementation and adoption of another as the benefit of one trickles to another. This approach will serve as an incentive where both upstream and downstream communities will be involved in implementing site-specific technologies and enhance collective actions. The kinds of technologies to be implemented will evolve from the community-based opportunity and constraint analysis conducted during the 2014/15 season. In addition to the introduction of new technologies, we will facilitate collective action, assist communities to develop and implement byelaws for resources management, jointly identify limitations/issues emerging from the participatory evaluation of the previous intervention options and organize trainings and demonstration to rectify the problems. Since there is great water resource potential in the Basona and Hossana AR sites, the project will give due attention to develop and management of water resources along with appropriate cropping system for the irrigated areas. Soil-crop-livestock system integration will be designed and implemented to enhance intensification and diversification across the landscapes (from upstream watersheds to farm levels). The conservation and SLM practices will also be integrated with productivity

enhancing technologies including integrated soil fertility management, growing fruit/vegetable crops, improved crop varieties, home-gardens, fodder, and cash crops. The project will technically support implementation of the R4D interventions and use the woreda level Strategic Innovation Platforms (IPs) and the kebele Operational IPs for cross learning and enhancing innovations. We will develop training modules and capacity development strategies with regards to water management, SLM and system intensification. Ex-poste and ex-ante analyses will be conducted to assess the productivity, profitability and resource use efficiency of interventions.

## Deliverables

Activity	Delivery dates
Report on consultation meeting and visit in the two AR sites	10-15 June 2015
Report on discussion with Woreda and Kebele officials on the principles of complementary-linked technologies and review existing interventions	20-25 June 2015
Install monitoring stations and train local people to collect data	20-25 June 2015
Result of ex-ante analysis of interventions: productivity and profitability	July – Oct. 2015
Model water flow and erosion processes	30 Sept. 2015
Training on complementary-linked technologies and implementation	30 November 2015
Participatory evaluation of technologies	30 December 2015
Field days involving communities from the two sites for experience sharing	30 December 2015
Community mobilized to co-initiate and implement water and SLM measures	Dec. 2015
Best-fit technologies implemented in a participatory manner	Dec. – Dec. 2015
Progress report related to the process, accomplishments and achievements	30 Jan. 2016
Report on impacts of interventions on water erosion, water yield and productivity	Feb. – April 2016
Workshop involving different partners and research community	30 May 2016
Digital stories and briefs on approaches and success stories	30 June 2016
Report related to outputs/outcomes and recommendations	30 June 2016
Draft journal article and prepare it for submission	30 June 2016

## Research Outcomes

The implementation of this project is expected to have the following outcomes:

- Community awareness resulted in ownership and full participation for implementation.
- Communities implemented sustainable land management and appropriate water harvesting measures.
- Soil moisture increased and soil erosion decreased as a result of integrated SWC efforts.
- New springs emerged and discharge of existing ones increased, shallow groundwater levels improved, harvested water provided irrigation.
- Livestock feed availability and soil health improved.
- Diversification such as fruits/vegetables and home-gardens improved nutritious food for household, especially for the youth and women.



- More resilient communities and landscapes to climate shocks and other external pressures created.
- Improved upslope-downslope community interaction to sustain conservation efforts.
- Integrated water and soil management model developed for extension officers, MoA and other partners for up scaling.
- AR and USAID have effective, functional demonstration sites which could be used for further monitoring and out/up-scaling.
- Training manuals and guidelines developed to aid out-scaling and technology dissemination.
- Realization of farmers/communities on the benefit/s of SLM will be created within and beyond the AR project sites

### Partners and Indicative Budget

Organization	Key contact	Indicative Budgets (USD)	
		Staff	Operational
CIAT	Lulseged Tamene (ltdesta@cgiar.org)	35,000	
ICRISAT	Tilahun Amede (t.amede@cgiar.org)	20,000	
ILRI	KinduMekonnen (K.Mekonnen@cgiar.org)	20,000	
IWMI	Valentine Gandi (v.gandi@cgiar.org)	12,000	
ICRAF	KirosHadgu (K.Hadgu@cgiar.org)	10,000	
Mekelle University	Kifle Woldearegay (kiflewold@yahoo.com)	15,000	
Research assistant		7000	
PhD student		10,000	
MSc students (2)	(To be identified)	5000	
Sub-total		134,000	116,600
Overhead (17%)		20,100	17,490
Sub-total including overhead		154,100	134,090
Total cost		288,090	

## Title: Facilitating market linkages between farmer agribusinesses with key buyers for potato, faba bean and wheat in the Africa RISING Ethiopia project

CIAT

### Theme

6: Cross Cutting Problems and Opportunities (Seeds, post-harvest management and markets)

### Activities Addressed

3.1.2. Determining effectiveness and impact of commodity marketing interventions.

### Justification

Lack of structured markets is major challenge for many farmers and traders caused by lack of organizing production and marketing institutions. Many farmers suffer from the problem of small quantities that usually is unattractive to many traders or buyers. This is due to high transaction costs and information problems, which present challenges in coordination of supply chains often leading to use of inappropriate varieties, underinvestment in storage and handling facilities, undersupply of finance and large intra- and inter-seasonal price fluctuations which undermine market participation and competitiveness. These are some of the challenges identified in the recent value chain studies by the project in the project sites. One way of structuring the market is through ensuring that producer institutions are well organized for collective marketing and that the producers are also able to access identifiable high value markets. This reduces costs of transacting between farmers and marketers. Building linkages for agricultural commodities by improving the capacity of existing agribusinesses (cooperatives and other farmer-based institutions and groups) to better link to end markets for commodities (large traders and processors). A focus on the complete value chain will ensure that other interventions at the farm level (such as water harvesting) support the market interventions. More important is that as farmers increase their production, they have defined markets for their commodity. The absence of an appropriate platform to facilitate these trading interactions reduces returns from farmers' farm operations. Low production and unreliable supplies and failure to meet desired quality and food safety standards for different markets, undermine development of competitive and equitable commodity value chains.

### Research Methods

To support scaling out of market linkages in each project site, potato agribusiness (farmer based) per site will be selected and supported to improve their market linkages to high value buyers and markets. A characterization of the current situation of the farmer-based agribusinesses that have interest in potato

value chains will be conducted in the project sites. The characterization will also target the market preferences for different potato products while targeting high value buyers. Modes of bulking and collectively marketing potato will be evaluated. Improved business models for linking between the agribusinesses and the key marketers will be explored jointly and improvements made. The models will be promoted through training and mentoring, and data collected over the project period to monitor performance and delivery of the market linkages efforts. Efforts will be placed on how existing facilities that can be used for bulking can be utilized by the agribusinesses while promoting post-harvest practices. Additional linkages will be established between the producers and the seed supply businesses to ensure that good quality potatoes are produced. Gross margin analyses and other indicators (volumes, prices, number of farmers engaged, type of markets accessed, etc) will be conducted to establish the impact of the market linkages. Appropriate business models for promoting linkages to the key markets will be designed or adapted, tested and evaluated for scaling in the framework of the innovation platform platforms in each of the Kebeles/sites.

## Deliverables

		Due Date
3.1.2.1	A characterization of the value chains and agribusinesses in the sites	30 June 2015
3.1.2.2	Mentoring facilitation workshops between producers and marketers	31 Aug 2015 to 31 Aug 2016
3.1.2.3	Monitoring implementation of progress and learning for scaling (including data collection)	31 Aug 2015 to 31 Aug 2016
3.1.2.4	Generation of research papers	From March 2016
3.1.2.5	Final project report	30 September 2016

## Research Outcomes

- Number of linkages between producers and buyers increased
- Volume of commodities transacted by the farmer-based agribusinesses increased
- Increased profit margins and incomes from the products for value chain actors
- Increased demand for and utilization of market support services
- Better response to quality demands in the value chains
- Increased participation of private sector actors on the innovation platforms

## Partners and Indicative Budget

Organization	Key contact	Indicative Budgets (USD)	
		Staff	Operational
CIAT	Eliud Birachi	86,000	To USD 32,200)
ILRI	Dirk	Self-budgeted	Africa RISING Ethiopia site field costs: 100,000
CIP	Wellington	Self-budgeted	

Organization	Key contact	Indicative Budgets (USD)	
		Staff	Operational
Sub-total		86,000	
Overhead, R&TS (20 %)		17,200	6,440
Total cost		103,200	38,640

## Title: Facilitating market linkages between farmer agribusinesses with key buyers for potato, faba bean and wheat in the Africa RISING Ethiopia project

CIAT

### Theme

6: Cross Cutting Problems and Opportunities (Seeds, post-harvest management and markets)

### Activities Addressed

3.1.2. Determining effectiveness and impact of commodity marketing interventions.

### Justification

Lack of structured markets is major challenge for many farmers and traders caused by lack of organizing production and marketing institutions. Many farmers suffer from the problem of small quantities that usually is unattractive to many traders or buyers. This is due to high transaction costs and information problems, which present challenges in coordination of supply chains often leading to use of inappropriate varieties, underinvestment in storage and handling facilities, undersupply of finance and large intra- and inter-seasonal price fluctuations which undermine market participation and competitiveness. These are some of the challenges identified in the recent value chain studies by the project in the project sites. One way of structuring the market is through ensuring that producer institutions are well organized for collective marketing and that the producers are also able to access identifiable high value markets. This reduces costs of transacting between farmers and marketers. Building linkages for agricultural commodities by improving the capacity of existing agribusinesses (cooperatives and other farmer-based institutions and groups) to better link to end markets for commodities (large traders and processors). A focus on the complete value chain will ensure that other interventions at the farm level (such as water harvesting) support the market interventions. More important is that as farmers increase their production, they have defined markets for their commodity. The absence of an appropriate platform to facilitate these trading interactions reduces returns from farmers' farm operations. Low production and unreliable supplies and failure to meet desired quality and food safety standards for different markets, undermine development of competitive and equitable commodity value chains.

### Research Methods

To support scaling out of market linkages in each project site, potato agribusiness (farmer based) per site will be selected and supported to improve their market linkages to high value buyers and markets. A characterization of the current situation of the farmer-based agribusinesses that have interest in potato

value chains will be conducted in the project sites. The characterization will also target the market preferences for different potato products while targeting high value buyers. Modes of bulking and collectively marketing potato will be evaluated. Improved business models for linking between the agribusinesses and the key marketers will be explored jointly and improvements made. The models will be promoted through training and mentoring, and data collected over the project period to monitor performance and delivery of the market linkages efforts. Efforts will be placed on how existing facilities that can be used for bulking can be utilized by the agribusinesses while promoting post-harvest practices. Additional linkages will be established between the producers and the seed supply businesses to ensure that good quality potatoes are produced. Gross margin analyses and other indicators (volumes, prices, number of farmers engaged, type of markets accessed, etc) will be conducted to establish the impact of the market linkages. Appropriate business models for promoting linkages to the key markets will be designed or adapted, tested and evaluated for scaling in the framework of the innovation platform platforms in each of the Kebeles/sites.

## Deliverables

#	Activity	Date Due
3.1.2.1	A characterization of the value chains and agribusinesses in the sites	30 June 2015
3.1.2.2	Mentoring facilitation workshops between producers and marketers	31 Aug 2015 to 31 Aug 2016
3.1.2.3	Monitoring implementation of progress and learning for scaling (including data collection)	31 Aug 2015 to 31 Aug 2016
3.1.2.4	Generation of research papers	From March 2016
3.1.2.5	Final project report	30 September 2016

## Research Outcomes

- Number of linkages between producers and buyers increased
- Volume of commodities transacted by the farmer-based agribusinesses increased
- Increased profit margins and incomes from the products for value chain actors
- Increased demand for and utilization of market support services
- Better response to quality demands in the value chains
- Increased participation of private sector actors on the innovation platforms

## Partners and Indicative Budget

Organization	Key contact	Indicative Budgets (USD)	
		Staff	Operational
CIAT	Eliud Birachi	86,000	To USD 32,200 +
ILRI	Dirk	Self-budgeted	
CIP	Wellington	Self-budgeted	

Organization	Key contact	Indicative Budgets (USD)	
		Staff	Operational
			Africa RISING Ethiopia site field costs: 100,000
Sub-total		86,000	
Overhead, R&TS (20 %)		17,200	6,440
Total cost		103,200	38,640

Item	Total cost	Remarks
CIAT		
International travel (NBO-ADD)	8,200	2 scientists, 4 times. Component planning meetings, platform interactive meetings in the project sites
DSA	5,000	4 field trips, 4 regions, 2 days each
Communications and office materials	4000	
Survey data management costs	15,000	Research assistants
SUM	32,200	
Overhead (20 %)	6,440	
Total sum, CIAT	38,640	
To be covered by AR-Ethiopia		
Local travel		For visiting other AR sites
Field labor for surveys		
Site meetings and planning workshops		
Field days		
DSA for counterparts		
Training workshops		
Car, fuel, etc.		
Evaluation workshops in Addis Ababa		
Total sum, AR-Ethiopia	100,000	approximately



## Title: Evaluating the costs and benefits of potato seed businesses in the Africa RISING Ethiopia project

CIAT

### Theme

6: Cross Cutting Problems and Opportunities (Seeds, post-harvest management and markets)

### Activities Addressed

1.2.1. Establish pilot potato seed supply systems via Innovation Platform and other partners

### Justification

Reliable supply of quality seed is necessary to sustain high productivity among the farming communities. However, in many places, seeds of self-propagating and self-pollinating crops may fail to provide adequate incentives for private sector to invest in their supply. Thus, seeds and planting materials that are released from the research process fail to reach the intended users due to lack of sustainable seed supply systems. The private sector feels that the returns on such investments are not assured. One of the challenges facing potato as an upcoming commodity enterprise is lack of consistent supply of planting materials, as shown by the recent value chain study in the project sites. The current system relies heavily on the public sector; however, a focus on seed supply as a business enterprise would link better the public sector (foundation seed) with the production of ware potato. A sustainable seed enterprise should be able to contribute increased potato production and consequently food incomes of households.

### Research Methods

Action research to promote seed businesses to supply potato seeds in each of the 4 sites will be implemented. Farmer based agribusinesses in the potato sub-sector will be capacity built to undertake potato seed production as a business and be able to supply to other farmers for ware potato production. At least one appropriate farmer-based agribusinesses (primary cooperatives, unions, and other farmer groups or associations) will be identified and encouraged to take on seed business. The agribusiness will be assisted to determine the profitability of the seed businesses and how to manage the businesses including participatory market research skills. They will also be facilitated to prepare seed business plans to produce seeds of preferred potato varieties. The seed businesses will be linked to target markets (other producer organizations and seed businesses). They will also be linked to market services such as credit to support their enterprises. The impact of seed businesses on seed availability and use will be evaluated at the end of the second year. The activity will be implemented in the framework of the established innovation platforms and will draw on the value chain results in the project.



## Deliverables

#	Deliverables	Due Date
1.2.1	A characterization of the seed value chains and agribusinesses in the sites	30 June 2015
1.2.2	Mentoring and training workshops between seed producers, users and marketers	31 Aug 2015 to 31 Aug 2016
1.2.3	Monitoring implementation of progress and learning for scaling (including data collection)	31 Aug 2015 to 31 Aug 2016
1.2.4	Generation of research papers	From March 2016
1.2.5	Final project report	30 September 2016

## Research Outcomes

- Number of linkages between seed producers, marketers and users increased
- Volume of seeds transacted by the farmer-based agribusinesses increased
- Increased profit margins and incomes from the seed enterprise for value chain actors
- Increased demand for and utilization of market support services by seed producers
- Better response to quality demands in the value chains

## Partners and Indicative Budget

Organization	Key contact	Indicative Budgets (USD)	
		Staff	Operational
CIAT	Eliud Birachi	Already covered by protocol above	CIAT Data entry: 12,000 (overheads apply) + Africa RISING Ethiopia site field costs: 60,000
ILRI	Dirk	Self-budgeted	
CIP	Wellington	Self-budgeted	
Sub-total		12,000	
Overhead, R&TS (20 %)		2,500	
Total cost		14,500	

Item	Total cost	Remarks
CIAT		
International travel (NBO-ADD)	0	2 scientists, 4 times. Component planning meetings, platform interactive meetings in the project sites
DSA	0	4 field trips, 4 regions, 2 days each
Communications and office materials	0	

Item	Total cost	Remarks
Data entry, software and management costs	12,000	Research assistants
SUM	12,000	
Overhead (20 %)	2500	
Total sum, CIAT	14,500	
To be covered by AR-Ethiopia		
Local travel		For visiting other AR sites
Field labor for surveys		
Site meetings and planning workshops		
Field days		
DSA for counterparts		
Training workshops		
Car, fuel, etc.		
Evaluation workshops in Addis Ababa		
Total sum, AR-Ethiopia	60,000	approximately



## Title: Evaluating the viability of a commercial spraying and mechanization services in the Africa RISING Ethiopia project

CIAT

### Theme

6: Cross Cutting Problems and Opportunities (Seeds, post-harvest management and markets)

### Activities Addressed

3.2.1. Support potential entrepreneurs to establish pilot services via Innovation Platform

### Justification

Value chain analyses and participatory community appraisals within the Africa RISING project in Ethiopia indicate that farmers are not able to use mechanization and chemical spraying services due to various reasons: either the services are not available or it is very costly for them to individually purchase the equipment required for these services. Moreover, the services are required only intermittently such that it is not worthwhile investing in the facilities for these services. As such, use of these services, some of which can drastically reduce drudgery especially for women who work on the farms, remain very limited. Productivity is thus compromised. Mechanization services include equipment that can work the farms faster, plant in lines, prepare feeding faster or quickly spray the animals and crops to prevent disease and pest attack. Some of these technologies have been piloted in the AR Ethiopia project and thus an assessment of their business potential will provide information on whether there are adequate incentives (demand and incomes) for private sector to invest in and scale out these kind of services. Models that can better support these kind of investments are also needed, and this intervention will contribute to providing the information.

### Research Methods

Within each project site, one service will be assessed for potential costs and returns. Potential investors in the services will be identified, and linked to the technologies and their skills, technical and business, enhanced. The targeted potential investors are private non-farmers as well as enterprising farmers that can provide the services to fellow farmers and will be approached and encouraged to invest in the project sites. The investor agribusiness will be assisted to determine the profitability of the services businesses and how to manage the businesses including participatory market research skills. They will also be facilitated to prepare service business plans. The service businesses will be linked to target markets via the innovation platforms (producers). Other project components will provide the operational know-how of the services. Necessary linkages to market services such as credit to support their enterprises will also

be established and encouraged. The costs and returns of the businesses will be evaluated after 2 seasons and potential for scaling documented.

## Deliverables

	Deliverables	Due Date
3.2.2.1	A characterization of the potential services in the sites	30 June 2015
3.2.2.2	Mentoring and training workshops between potential and actual services providers and potential users (producers, users and marketers)	31 Aug 2015 to 31 Aug 2016
3.2.2.3	Monitoring implementation of progress and learning for scaling (including data collection)	31 Aug 2015 to 31 Aug 2016
3.2.2.4	Generation of research papers	From March 2016
3.2.2.5	Final project report	30 September 2016

## Research Outcomes

- Number of services providers increased
- Volume of services business transacted by the providers and users increased
- Increased profit margins and incomes from the services enterprise for value chain actors
- Increased demand for and utilization of the services by producers
- Reduced drudgery by men and women farmers
- Increased linkages by service providers to other input suppliers

## Partners and Indicative Budget

Organization	Key contact	Indicative Budgets (USD)	
		Staff	Operational
CIAT	Eliud Birachi	Already covered by protocol above	CIAT Data entry: 12,000 (overheads apply) + Africa RISING Ethiopia site field costs: 90,000
ILRI	Dirk	Self-budgeted	
CIP	Wellington	Self-budgeted	
Sub-total		12,000	
Overhead, R&TS (20 %)		2,500	
Total cost		14,500	

Item	Total cost	Remarks
CIAT		
International travel (NBO-ADD)	0	2 scientists, 4 times. Component planning meetings, platform interactive meetings in the project sites

DSA	0	4 field trips, 4 regions, 2 days each
Communications and office materials	0	
Data collection and monitoring costs	12,000	Research assistants
SUM	12,000	
Overhead (20 %)	2500	
Total sum, CIAT	14,500	
To be covered by AR-Ethiopia		
Local travel		For visiting other AR sites
Field labor for surveys		
Site meetings and planning workshops		
Field days		
DSA for counterparts		
Training workshops		
Car, fuel, etc.		
Evaluation workshops in Addis Ababa		
Total sum, AR-Ethiopia	40,000	approximately



# Title: Addressing the yield gap challenge in the Ethiopian highlands through improved management practices

**CIAT**

## Theme

2: Field Crop Varietal Selection and Management

## Activities Addressed

2.2.1 Review and evaluate incompatibilities between existing and improved management practices required for optimum production from improved varieties (aligned with 1.1.2.);

2.2.2 Trade-off analysis to evaluate the feasibility of improved management practices;

2.1.2 and 2.2.3 Participatory evaluation of improved management practices including fertilizer regimes in conjunction with new varieties management options [aligned with varietal selection]

## Justification

A first step towards demonstrating the potential to greatly reduce the existing yield gaps in AR sites through matching crop-specific fertilizer regimes, including types and amounts, with local soil and seasonal climate conditions coupled with the use of improved crop varieties was initiated during the just concluded year. The initial results show a lot of potential to reduce yield gaps through improved agronomic practices. Use of combinations of fertilizers with manure resulted in improved yields but manure use is not common to all sites, yet best soil management requires combinations of chemical fertilizer with organic resources. Demonstrating the initial successes to more farmers is important and, where this is combined with participatory technology evaluation and field days should result to technology uptake by farmers. Demonstrations conducted will, besides enriching first seasons' data that investigated the principle that yield is a function of environment and management, seek to move farmers from the current practice of low input use to a profitable use of improved seed, optimal fertilizer amounts, nutrients (organic and inorganic), while adapting the technologies to the varied local conditions. Applying this concept can significantly help address the yield gap observed on many smallholder farmers' fields, while at the same time, equipping them with skills to improve farming.

## Research Methods

In 2014/15, demonstration trials and agronomic surveys to assess yield gaps were implemented. During 2015/16, four demonstrations will be conducted in Debre-Birhan and Lemu for use in farmer training embedded within participatory evaluation and field-days. In Sinana and Tigray where only few

demonstration trials were conducted last year, 8 demonstrations will be conducted per site. Attempt will be made to use similar fields as last season where applicable in order to quantify the residual effects especially of the micronutrients. A manure treatment will be included in all sites. The same 4 or 8 farmer fields per site will be used for farmer technology assessments and subsequently field days. We will document the challenges that farmers perceive in the uptake of the promoted technologies and this will be captured during the participatory technology evaluation and will include farmers who experimented in own fields in 2014/15. Unlike, last year, we will use one improved wheat variety, established under best management practices including row planting. Key focus will be on the 4Rs of nutrient management. Input costs and output data will be collected. The new farmer fields will be characterized to allow comparison of agronomic data with those (existing from last year) that are already characterized.

## Deliverables

Deliverable	Due Date
At least 50 farmers in each of the 3 AR sites trained on at least two crop yield enhancing technological packages identified during the last season.	December 2015
Documented farmer perceived challenges in uptake of best-bet technologies	December 2015
Inventory of agronomically and economically feasible best-bet management practices in Tigray and Sinana	March 2016
Recommendations on possible adjustments in fertilizer types based on soil analysis for different AR sites	March 2016
Expanded dataset of productivity and profitability margins of various technologies	April 2016
Report submission and a draft journal paper	May 2016

## Research Outcomes

This work will provide information on the missing links in soil and crop management in AR sites (initially in two sites) in Ethiopia. It will demonstrate best management approaches for improved crop productivity to over 150 farmers. Through this, a yield increase of at least 25% is expected among practising farmers. A catalogue of technologies that have potential for profitability under local conditions in each of the villages will be developed. The findings of the research will be presented at a community workshop for validation and dissemination. By linking with proposed soil fertility and alternative erosion management activities (3.1.1-3 and 4.1.1-2) under Theme 4 and results of work on varietal selection, technology packages that will be demonstrated stand a high chance of success. The work will also enhance the capacity of existing extension personnel who will continue to have impact on the villages beyond the project life.

## Partners and Indicative Budget

Organisation	Key contact	Indicative Budgets (USD)	
		Staff	Operational
CIAT	Biyensa Gurmensa	10,000	
CIAT	Job Kihara, Lulseged T.D.	25,000	52,010
ICRISAT	Tilahun Amede (t.amede@cgiar.org)	5,000	
ARCs	(To be contacted)	8,000	
Sub-total		48,000	52,010
Overhead, R&TS		8,800	
Total cost		56,800	108,810



## Title: Strengthening national capacities in monitoring, evaluation and communication of soil fertility management practices that counteract soil fertility depletion

CIAT

### Theme

Theme 4: Improved Land and Water Management for Sustainability

### Activities Addressed

- 3.1.1. Identify key soil fertility problems faced by farmers and construct an inventory of possible solutions.
- 3.1.2. Conduct ex ante impact assessment and trade-off analysis with crop-soil simulation models.

### Justification

The 2014-15 soil fertility (mainstreaming) protocol was successfully carried out in the Amhara and SNNPR Region (Debre Birhan and Hosainna) covering the two crops wheat and faba bean. It was accompanied by a systematic assessment of soil and land health at landscape level employing the Land Degradation Surveillance Framework, as well as by a one week introductory crop model training to in total 21 national scientist from Ethiopia, and a follow-up in-depth training of the two site coordinators on using biophysical modeling to assess soil fertility constraints at sub-regional scale.

It became obvious that there is a notable lack of national scientist's capacity in the monitoring, evaluation and communication of soil fertility management practices that counteract soil fertility depletion, and that go beyond the mere conveying of, to some extent, outdated (and exaggerative) recommendations for application of mineral only fertilizer. To lay a sustainable basis for protecting and rehabilitating soil health in Ethiopia that lasts beyond the lifetime of AfricaRISING, it is therefore paramount to invest in further capacity building at that level. To that end, joint monitoring of crop performance and yield is required, which will be done in collaboration with (CIAT and ICRISAT led) sister-protocol that focus on the participatory evaluation of best-bet fertilizer (and organic matter) management practices at farmer's fields.

Surveys carried out by Africa Rising in 2013 revealed that inappropriate soil fertility management in the eight selected Kebeles in general, and absence of rational use of mineral fertilizer in the Gudo Beret Kebele (Amhara Region) and Jawe Kebele (SNNPR Region) in particular, lead to soil mining and a loss of soil fertility. However, more in-depth information of major is missing. In addition, there is no adequate information on appropriate fertilizer recommendations that address issues of soil health while at the same time are acceptable by the farming community. Likewise, it is currently unknown what incentives would be required for smallholders to adopt sustainable land management practices, if such entail tradeoffs that

currently provide disincentives for farmers to change business-as-usual practices. Computer simulation tools, such as crop-soil simulation models, provide options for fast and wide-scale assessment of soil fertility dynamics and impacts of organic and/or inorganic fertilizer management practices in a predictive fashion. They are ideal tools to carry out scenario (what-if) analyses under current and best-bet, sustainable intensification conditions. These can also be used in combination with other models (livestock production models, household consumption models), to analyze soil fertility – agricultural production – livelihood tradeoffs.

## Research Methods

To provide accurate input data for engaging in crop modeling, we will be repeatedly collecting crop phenological (wheat, barley, faba bean or chick pea) and soil data in four farmer's field (that have been selected by the sister-project on the Yield Gap assessment) in two sub-regions in each of the aforementioned Kebeles. These data sets will allow us to calibrate the crop model, CropSyst, for at least two major crops and enable us to develop best-bet soil fertility management practices, especially focusing on maintaining or improving long-term soil fertility (using soil organic matter as an indicator). These data will complement the already existing data sets and will provide us with the full picture of issues around soil fertility and how to maintain or improve it for the whole set of AR sites.

A major focus of this activity will be on capacity building of Ethiopian national scientists. This will comprise the aforementioned (always) required gathering of suitable data sets, an advanced one-week training course on crop modeling, as well as selected, repeated 1:1/few short-term on-the-job training sessions either in Addis Ababa or in the AR regions. The training will comprise teaching the concept of integrated soil fertility management, eco-efficiency (putting resource use efficiency rather than economic profits in the foreground) and climate smart agriculture, and how crop modeling can be used to predict suitable metrics, including for instances the prediction of greenhouse gas emissions and the calculation of the greenhouse gas footprint of current and sustainably improved crop management practices.

## Deliverables

Deliverable	Date due
Monitoring of crop growth and yield finalized, and data organized	Dec. 2015
One-week, advanced CropSyst crop modeling course in Addis Ababa	Dec. 2015
At least two one-to-one/few individual two-day training courses in the two regions completed	Feb.-April 2016
All field (soil, crop) monitoring data published online for open access	March 2016
Crop model calibration data sets finalized and published online for open access	May 2016
Pathways for eco-efficient, climate smart and soil conserving agricultural management practices defined, discussed with AR-experts, and communicated	June 2016

## Research Outcomes

- National Ethiopian scientists will be in a better position to improve fertilizer management recommendations while accommodating soil fertility constraints, the sustainability of intensified crop production, as well as farmers socio-economic constraints
- Farmers in the selected Kebeles consider soil fertility management in their planning
- Sustainably increased crop production
- Reduced vulnerability and production risk (risk of investment in inputs) of smallholders in the selected Kebeles
- Informed decision making by local, regional, and national stakeholders will strengthen
- Communicating results in workshop will strengthen stakeholders buy-in
- Reports, training manuals and articles

## Partners and Indicative Budget

Organization	Key contact	Indicative Budgets (US\$)	
		Staff	Operational
CIAT	Biyensa Gurmessa - 33 % (b.gurmessa@cgiar.org)	15,000	(details see next table)
CIAT	Rolf Sommer - 15 % (r.sommer@cgiar.org)	25,000	
ICRISAT	Tilahun Amede – 5 % (t.amede@cgiar.org)	10,000	
ICARDA	Mariya Glazirina – 10 % (m.glazirina@cgiar.org)	10,000	
Sub-total		60,000	37,116
Indirect costs, R&TS (20 %)		12,000	7,423
Sub-total + indirect costs		72,000	44,539
TOTAL			116,539

Item	Total cost (US\$)	Remark
CIAT		
International travel (NBO-ADD)	4,000.00	2 scientists, 4 times
DSA	2,000.00	2 scientists, 6 field trips, 2 regions, 2 days
Chemical analysis 144 soil samples	5,472.00	4 sites, 4 fields, 3 reps, 3 depths
Chemical analysis 432 plant samples	7,344.00	4 sites, 4 fields, 3 reps, 3 crops, 3 times
Sample shipment	1,800.00	ADD→NBO
Two AccuPar leaf area index devices	8,000.00	Non-destructive monitoring of crop growth
Advanced crop model training workshop in Addis Ababa, 5 days, 10 participants	8,500.00	
SUM	37,116.00	
Indirect costs (20 %)	7,423.20	
Total sum, CIAT	44,539.20	
To be covered by AR-Ethiopia		
Local travel		
Field labor, repeated biomass sampling		



Item	Total cost (US\$)	Remark
Site team meetings		
Logistics and cost associated with 1:1 training of Ethiopian national scientists		
DSA for counterparts and site coordinators		
Field vehicle, fuel, driver		

## Title: Participatory evaluation of techniques to introduce the utilization of dual-purpose cereals by farm households

ICARDA

### Theme

Feed and Forage Development

### Activities Addressed

- 5.1.1. Conduct a broad-based study of biomass availability and assess potential feed values and trade-offs
- 5.1.2. Incorporate promising sources of feed biomass into research conducted

### Justifications

Growing cereal crops for the dual purposes (DP) of livestock forage during the early vegetative stages and harvesting grain at maturity has been practiced all over the world for decades. Appropriate defoliation through grazing or mechanical clipping is essential for ensuring grain yield recovery is maximized (Harrison et al. 2011). Opportunities for feeding foliage from growing cereals and how these crops should be managed to maximize regrowth and grain recovery has received little investigation in Ethiopia. Exploring the effects of defoliation on cereal cultivars and their capacity to recover their growth and grain yield is required to better understand their potential for dual-purpose use in mixed-farming systems.

DP cereal are a valuable resource and an attractive management option to farmers for numerous reasons. First, cereal forage provides an alternative source of feed during feed scarcity at the beginning of the rainy season when growth of pastures is generally less than livestock requirements. Second, DP crop foliage has high digestibility and crude protein content and is thus beneficial to improve livestock weight gain (Dove and McMullen 2009). Third, both experimental and modelling studies have often demonstrated that DP crops are more profitable than grain-only crops, since income can be generated from both livestock and crop resources, which in the long term mitigates risk (Moore 2009).

The first objective is to test the viability/uptake of this practice in the AR sites and determine available biomass and nutritive value of early vegetation stages of cereal foliage for livestock.

Effects of utilizing different DP cereals, undertaking mechanical clipping cutting or grazing management or different environmental conditions on shoot dry matter (stubble) and grain yield relative to ungrazed crops are highly variable, ranging from moderate to minimal yield penalties to increases in grain yield. Thus, the second objective will be to determine the effects of DP crop management alternatives (e.g. optimal vegetative stage and optimal number of times mechanical clipping can be undertaken on green fodder biomass, grain yield and straw quality and yield at harvest and develop clear guidelines for dual purpose use.



## References

Dove, H. and K.G. McMullen. 2009. Diet selection, herbage intake and liveweight gain in young sheep grazing dual-purpose wheats and sheep responses to mineral supplements. *Animal Production Science* 49, 749–758

Harrison, M.T., Evans, J.R., Dove, H. and A.D. Moore. 2011. Recovery dynamics of rainfed winter wheat after livestock grazing. 1. Growth rates, grain yields, soil water use and water-use efficiency. *Crop & Pasture Science* 62, 947–959

Moore, A.D. 2009. Opportunities and trade-offs in dual-purpose cereals across the southern Australian mixed-farming zone: a modelling study. *Animal Production Science* 49, 759–768

## Research Methods

### Deliverables

Deliverable	Date due
Formation of farmers groups	July, 2015
Farmer perceptions of utilizing cereal foliage as feed	August, 2015
Development of cutting protocols techniques for action research	August-Nov, 2015
Meeting with kebele and woreda innovation platforms	Sept., 2015
Implementation of new practices by farmer groups	Dec., 2015
Report on participatory evaluation of the new practices	March, 2016
Report on development of protocols/strategies/guidelines to utilize DP cereals	April, 2016
Data analysis, report writing and publications	May-June 2016

### Research Outcomes

The expected outcome of this research is that farmers in the research sites will be acquainted with and adopt new technologies that provide additional and alternative fodder supply to livestock. The techniques will help farmers to effectively utilize the available crop residue biomass and increase their farm productivity. During the evaluation process, forums will be created where farmers within and outside the group will share knowledge and experiences on how to further improve the handling and utilization of crop residues. This will in turn increase awareness among farmers and enable to initiate a new round of participatory research.

## Partners and Indicative Budget

Organization	Key contact	Indicative Budgets (USD)	
		Staff	Operational
ICARDA	Jane Wamatu (5 days/month), Barbara Rischkowsky (total of 10 days), Research assistant (15 months) shared between ICARDA and ILRI for this protocol	50,383  22500	Establishment of plots, inputs, labour, harvest, travel and laboratory costs 25,000
ILRI	Melkamu Bezabih, Alan Duncan, Kindu Mekonnen, Aberra Adie, Peter Thorne	Melkamu: 5 days per month	
Site teams	Sinana ARC – wheat system Debre Birhan – barley system Endemehoni – wheat/barley system		



## Title: Smart marketing of small ruminants in selected Africa RISING sites of Central Ethiopia

**ICARDA**

### Theme

Theme 6: Cross-cutting problems and opportunities

### Activities Addressed

3.1.2. Determine effectiveness and impact on input and output marketing interventions for crop and livestock products

### Justification

Smallholder farm households are too small to influence the market with their individual marketing behavior. They are always less informed than the other actors in the market exposing them to the blunt forces of the market that arise from considerable information asymmetry. Although men and women small ruminant keepers face significant barriers to effectively engage in markets, their patterns and barriers of market engagement differ. Women's capacity to effectively engage in markets is differentially constrained by their more limited access to and control of productive resources, and constraints on their time and mobility.

Farmers' associations/groups established based on voluntary basis can certainly enable men and women farmers to be powerful actors in the markets. The important role that collective actions play in increasing the bargaining power of smallholder producers is well documented. However, there are no studies that address gender dimensions in small ruminant collective marketing and how these affect men and women's market participation, satisfaction and welfare. Lack of this information affects effective design and implementation of effective value chains interventions that benefit both men and women small ruminant producers.

### Research Methods

The research combines access to market information and informal grouping of smallholder farmers as an experimental variable. Taking into consideration both grouped and ungrouped small ruminant keepers, the research aims at developing a mechanism whereby key actors along the value chain do communicate continuously to reduce haphazard/accidental marketing of animals. The study will be implemented in 6 treatment and 6 control markets in Debre Birhan Zuria and Limu Africa RISING sites. 50 participant farm households will be identified around the intervention markets. When applicable, 10 farmers will be grouped in an informal way and will be associated with a trader they are most familiar with. The



households would be stratified as women headed and male headed and then proportional random sampling will be employed to identify the 50 sample households. Sample male headed households would be given the option of having women participate in the grouping and accessing information when applicable. Market information on trait preferences, price expectations, quantity demanded, quantity supplied, availability of and access to market services, and key social [e.g., extraordinary social occasions] and environmental [e.g., profound shifts in the weather] phenomena will be monitored, synthesized and communicated to all key actors along the value chain within a manageable scope that will be determined in view of the resources to be generated. Communication of market information will be done every 15 days with qualified researchers from Debre Birhan and Areka Research Centers. The information to be provided to men and women farmers will be uniform.

## Deliverables

Deliverable	Date due
Rapport development with administrative and agricultural development institutions	30-Aug-15
Developing checklist for reconnaissance survey	15-Sep-15
Conducting reconnaissance survey and report write up	30-Sep-15
Developing instrument and sampling framework for baseline survey	31-Oct-15
Conducting baseline survey	31-Dec-15
Baseline report writing and developing benchmarks of key indicators	28-Feb-16
Sampling framework for group formation	15-Jan-16
Gender awareness creation for group formation	30-Jan-16
Facilitating informal group formation	28-Feb-16
Discussion with farmers on marketing variables on which data and information is to be generated and communicated	30-Mar-16
Developing a framework to collect, collate, synthesize and disseminate data and information on the selected variables	30-Mar-16
30 Rounds of collecting, collating, synthesizing and disseminating data and information to group of farmers identified on the selected variables	30-Nov-16
Checking the sampling framework and the instrument for impact assessment survey	30-Nov-16
Conducting the survey	30-Dec-16
Report writing and quantifying the gender disaggregate welfare impact of access to market information and collective action	30-Jan-17

## Research Outcomes

This study has three broad outputs:

1. Comprehensive data and information on the structure and behavior of the small ruminant markets in the two study sites (i.e., Debre Birhan and Limu),

2. Gender responsive framework to collect, collate, synthesize, and disseminate market information on small ruminants, and
3. Gender disaggregated analysis of the welfare impact of access to market information and collective actions in small ruminant marketing.

### Partners and Indicative Budget

Organisation	Key contact	Indicative Budgets (USD)	
		Staff	Operational
ICARDA	Girma T. Kassie, Barbara Ritchkowsky, Research Assistant, Field Coordinators, PhD Student	72,200	85,905.00
ILRI	Annet Mulema	13,200	
Debre Birhan A R C Areka A R C	Agr. Economist, and livestock specialist	12,000	
PhD Student (Research only)		5000	
Sub total		188,305	
Overhead (13.24%)		24,932	
Total		213,237	

# Title: Optimal temporal and spatial tree crop livestock system integration for improved yield, biomass, nutrient cycling, energy efficiency and carbon sequestration

**ICRAF**

## Theme

Theme 5: Improving the Efficiency of Mixed Farming Systems through more Productive Crop - Livestock Integration

## Activities Addressed

2. Establish optimal crop residue, tree shrub litter production, manure-compost use strategies for crop livestock systems.

2.1.1. Use systems models to examine bio-physical options as alternatives to crop residue management and utilization strategies.

2.1.2. Implement WaNuLCAS: tree-soil-crop interactions and agroforestry management options and optimal resource use efficiency models for tree crop residue trade-off analysis.

2.2.3. Inventory manure compost production and availability on farms and identify potential opportunities to expand the system.

3.1.2. On-farm testing and evaluation of promising and fast-growing tree species.

Temporal and spatial

## Justification

Many farmers, in the AR sites, are dealing with highly degraded landscapes and severe soil erosion, and large number of farmers' fields/plots are located on steep slopes that are vulnerable and are under current traditional continuous cultivation systems. Soil loss in the Ethiopian highlands, exacerbated by deforestation, is estimated at almost 1.5 Mt a<sup>-1</sup> (Zeleeke and Hurni, 2001), responsible for an estimated loss in grain yield of 1-1.5 Mt a<sup>-1</sup> (Taddese, 2001). Scarcity of fuelwood in many rural areas compels farm households to burn manure and crop residues for household energy (both cooking and heating). This would decrease crop yields by limiting nutrient cycling that could have been added to the soil through decomposition and limiting the supply of animal feed (Tizale, 2007). Farmers have limited access to external inputs such as fertilizer, quality seeds, pesticides, specialized machinery and appropriate farming technologies. Fertilizer use by smallholder farmers has remained at very low levels because of price and low awareness. Even where farmers can afford fertilizer, low and erratic rainfall further reduces fertilizer mobilization and use efficiency by crops. Since the land frontier is virtually closed, increases in agricultural

production can only come from sustainable intensification of the already existing agricultural systems. However, a significant increase in agricultural productivity cannot be attained if the land resource base continues to be degraded and misused. There is scope for more effective crop - tree - livestock integration to reverse the negative trend, and depending upon effective temporal and/or spatial incorporation of trees and vegetables into agricultural landscapes that would contribute to: (i) maintaining soil vegetation cover year-round, (ii) boosting nutrient supply through nitrogen fixation and litter decomposition and nutrient cycling, (iii) enhanced suppression of pests, plant diseases and weeds, (iv) improved soil structure and water infiltration, (v) greater direct production of food, fodder, fuel, fiber and income from products produced by the intercropped trees, (vi) increased quality soil organic matter and enhanced carbon storage both above- and below-ground, (vii) more effective conservation of above- and below-ground biodiversity, and (viii) enhanced societal and ecosystem resilience to climate variability and climate change. However, integrating trees into livestock and cropping systems is knowledge intensive as it involves both positive and negative component interactions. Hence, approaches to matching the right trees and management practices to production systems and ecosystems are required; and this requires making effective use of a combination of farmer preferences and science-based understanding of component interactions.

## Research Methods

The Africa RISING project is introducing improved technologies, crop varieties, livestock and trying to promote portfolios of tree species (tree Lucerne and fruit trees (Apple, Avocado), fast growing fuel wood tree species (e.g. *Acacia decurrens*) and management options that meet income, fodder, fruit, fuelwood and soil fertility demands. A novel aspect of this protocol is in bringing together tree, crop, livestock, soil and water expertise to quantify the synergies and trade-offs for optimal and efficient integrated system. We will establish an experimental plot (and on farm) on two AR sites (Lemo and Debrebirhan/or Tigray). We will design different spatial and temporal integration options in order to determine the best management options and combinations. This study will further explore system interactions and dynamics by looking at patterns of firewood and cattle dung use for energy use and their implications for food crop production, tree regeneration and community level carbon emission reduction potentials. The effect of Eucalyptus species woodlots compared with other species on soil physico-chemical properties and understory biomass production and its implication for soil and water conservation and livestock production will be assessed. Soil samples will be collected and analysed for major nutrients under the different trees and manure (trade-off between nutrient and energy use efficiency). Measure performance of animals (milk productivity). Where the management of open livestock grazing is fundamental to the success of tree establishment, we will monitor under what circumstances and niches does the farmers prefer to plant trees and see the benefits, (managing their livestock or fencing their valuable trees on farms). Periodic yield measurements (crop, potato yield, vegetable etc). Competition for water will be assessed using soil water content and plant water potential measurements. Above and below ground carbon and biomass will be quantified. Fruit, fuelwood, fodder, timber and other biomass products, and income will be measured periodically. The potential fuel and CO<sub>2</sub> emission reductions that could occur through using improved stoves or clean renewable energy sources will be assessed. Trade-off analysis will

be carried out for various competing uses of trees-crop-livestock-labour-and environmental benefits. Mixed methods including household surveys, on-farm testing, nutrient content of litters from intercropped plants, cattle dung, and calorific value of selected firewood species will be analyzed and estimated. Calculations of fuel and emission reductions and modelling will be used to understand key synergies and trade-offs. This will involve a joint PhD student if possible.

## Deliverables

Deliverable	Date due
Formation of experimental plots (on farm and research site) to quantify trade offs	June 2015
Inventory of tree density per household	July 2015
	August 2015
Asses patterns of manure/compost and crop residues use for soil fertility	October 2015
Journal article on synergies and trade-offs	September 2016

## Research Outcomes

Choosing trees that will tighten nutrient and water cycles and produce abundant fertilizer, fruit, timber, fodder, fuel, biomass in different planting contexts requires effective use of a combination of farmer preferences and science-based understanding of component interactions. Reclaiming degraded areas and restoring their productive capacity needs to also include consideration of the watershed issues where trees operate as keystone farm and landscape elements, in that a small change in tree cover at particular locations in the landscape can have large consequences for hydrology and overall ecosystem health. The results from this detailed experimental research will enable to quantify synergies and trade-offs among the different components to design optimal temporal and spatial integration of trees - crop-livestock. This will guide policy makers for holistic system approach to break the negative cycle of deforestation, soil degradation, lack of grazing area and fodder, lack of fuel, poor crop productivity, malnutrition and lack of food security.

## Partners and Indicative Budget

Organization	Key contact	Indicative Budgets (USD)	
		Staff	Operational
ICRAF	Aster Gebrekirstos (supported by other ICRAF experts-Kiros Akilu, Nigusse and Hadia)		
ILRI	Peter Thorne, Kindu Mekonnen- and Alan Duncan		
CIP	CIP (Wellington?) Miriam (nutrition)		
IWMI	Valentine		



Organization	Key contact	Indicative Budgets (USD)	
		Staff	Operational
Other potential partners			
PhD student (ILRI rate for three years)			
	Total		

## Title: Reaching wider communities with Stratified, Land Quality based Fertilizer Recommendation in Ethiopia: evidence for policy influence

ICRISAT

### Theme

Field Crops Varietal Selection and Management

### Activities Addressed

2.1.1 Review information on locally targeted fertilizer recommendations

2.1.2 Participatory evaluation of alternative fertilizer regimes

### Justification

Wider use of appropriate amount and combination of fertilizers is one of the major strategies to increase crop yield and productivity of small-scale farmers. Although land degradation and nutrient mining is a widely recognized production constraint in the country, crops are not always responding to the application of conventional macronutrients, even in soils where application of chemical fertilizers is a first-time experience. As a result, the objective of the Ethiopian government to increase yield per unit of land and labour and to improve food security has remained to be a challenge. There was unproven local perception that crops in the Ethiopian soils are not responding to the application of some nutrients (e.g. K). As a result, the Government of Ethiopia, the sole importer of farm inputs, has been importing only Nitrogen and Phosphorus fertilizers to the country. However, in the last few years, the Ministry of Agriculture and the Agricultural Transformation Agency (ATA) have been investing hugely to develop soil-test based fertilizer recommendations in the country, with visible progress. The new policy direction is to import and locally process blended fertilizer types, which are incorporating micronutrients and other major macro nutrients, a departure from the commonly used DAP and Urea fertilizers. This policy is based on the belief that when micro-nutrients become a limiting factor water, fertilizer and other high-energy production inputs may be wasted, since a plant will only grow and develop to the extent that its most limiting growth factor will allow (Mengel, 2012). Many times the hidden hunger for micro and secondary nutrients is not visible, however, such deficiencies make plants vulnerable to attacks by pathogens and insect pests and also the symptoms are considered as disease symptoms. ICRISAT's participatory research for development approach using watershed and soil test-based nutrient management as an entry point in Bhoochetana, the state of Karnataka, India (ICRISAT, 2013) have shown that rainfed crops respond very well to application of deficient micro nutrients (zinc, boron and sulphur) and increased crop yields by 20 to 66% on 3.7 million hectares, with an economic impact of around US\$ 130 million. The economic returns of Bhoochetana revealed that benefit cost ratio for the farmers were 2.1 to 15:1 with full costing of the inputs added by the farmers (ICRISAT, 2013). Based on the evidence of strategic research undertaken by

ICRISAT-led consortium in India and other countries in Asia we have undertaken an assessment and on-farm pilot testing of various combinations of micro, macro and secondary nutrients in four AfricaRISING sites, with about 110 farmers' fields in the year 2014. Our preliminary results suggested that a) the recommended amount and combination of fertilizers by the Ministry of Agriculture is much higher than crop requirements under the current production environments and found to be non-economical to farmers in three out of the four sites; b) Crop responses to fertilizer application were diverse and variable within a Kebele, calling for fertilizer recommendation following a landscape-approach; and c) the current fertilizer recommendation is crop-based, while efficient nutrient management should be cropping-system based. our random selection of farmers gave us a clue about the need for a stratified crop-response trial, so that farmers will have the possibility to use the right amount and types of fertilizer to apply in their farm niches in different landscape positions. Our major research engagement in 2015/16 will have three sets of initiatives; 1) Scaling-up best-bet fertilizer combinations for each targeted Landscape positions, in 200 farms per kebele, a total of 1000 farms; 2) After-effect trials to establish recommendation at cropping system scales: we expect residual accumulation of nutrients from our 2014 applications in the farmers fields; testing after-effects of residual fertilizer on potato (Sinana, Bosenana), faba bean (Mohoni) and early maturing maize (Lemu); and 3) Modul training on 'fitting fertilizer types to systems' for development agents, regional researchers and development partners on targeting.

## Research Methods

We will work in all four AfricaRISING districts (Mehoni, Lemo-Jawe kebele, Basona worena-Goshe bado and Sinana-salke), where we had already solid partnership with farmers and local partners. In this second season, we will scale-up targeted fertilizer types to targeted landscapes to 1000 farmers but also assess the aftereffects on additional 110 farmers, on our 2014 farmers' fields. Participatory analysis of effects of nutrient regimes on crop quality, grain yield, biomass yield, pests and disease and other relevant parameters will be conducted. Fertilizer response maps will be created for each kebele. This will lead not only for district/Kebele-wide nutrient management recommendations for major cropping systems in the regions but also would be used as evidence for wider policy influence.

## Deliverables

Deliverable	Date due
A Cropping-system based, stratified fertilizer recommendation	Feb 30, 2016
Scaling-out targeted, economical fertilizer blends to 1000 households	Dec 30, 2015
Report on the effect of application of various micro and macro nutrients on nutritional quality and livestock feed quality	Jan 30, 2016
Report on cost-benefits and farmers assessment of fertilizer blends	November 15, 2015
Policy recommendations on fertilizer management and scaling up strategies	March 30, 2016
Report on creating capacity and sharing the methodology widely	May 15, 2016



## Research Outcomes

- Increased crop productivity and quality with high nutrient use efficiency in wider areas
- Fertilizers response maps for the selected kebeles will be available to share the information with different stakeholders and enhance the awareness amongst the policy makers, development workers, researchers and farmers for increasing agricultural productivity
- A ‘proof of concept’ of scalable participatory research for development using fertilizer use efficiency as entry point for wider influence in sustainable intensification.
- Enhanced local capacity to facilitate system change, through improved soil fertility management
- Policy influence on the quality and type of fertilizer investment in Ethiopia
- Increased productivity of crops through enhanced nutrient and water use efficiency to benefit the farmers.

## Partners and Indicative Budget

Organization	Key contact	Indicative Budgets (USD)	
		Staff	Operational
ICRISAT	Tilahun Amede / Sridhar Gummadi	54,900	37,200
CIAT	Lulseged Tamene / Rolf sommer	15,000	
ATA	Selamyhun Kidanu	20,000	
Regional Research Centres	SARI and ARARI	6,500	3000
	Administration cost (16.7%)	16,099	6,713
	Sub-total	112,498.80	46,913
	Total		159,412.20

## Title: Farm-typology based Interventions for Improved Nutrition, Income and Resilience in AfricaRISING sites, Ethiopia

ICRISAT

### Theme

Nutrition and Food Security (No theme on this yet!). The closest is Theme 5.

Theme 5. Improving the efficiency of mixed farming through more effective crop-livestock integration

### Activities Addressed

The closest activities are 5.1 and 5.3

### Justification

Intensification of agricultural systems in Ethiopia should not be only about increasing yield of food crops, it should rather consider nutrition and environmental tradeoffs as central focus to ensure sustainable production systems. However, food shortage in Ethiopia is predominantly taken as a function of limited access to food in terms of quantity. The current grain-based cropping system lacks real incentives for diversification of crops and nutrition-oriented innovative farming. Malnutrition of the vulnerable groups (children and women) could occur even in good crop harvest years and in regions of high potential because of non-balanced food intake and lack of diversity. Rural households rarely consume animal products as they are scarce sources of cash. Dietary supplements are also rarely available to the rural poor. Therefore, there is a need to establish the level of hidden hunger in the Ethiopian highlands, particularly in districts where AfricaRISING has been operating. We suggest the development of household level farm intensification strategy that would consider land holdings, resources base, labour availability, gender and household nutrition. Our strategy was to reverse the risk of malnutrition and low farm income by modifying the production system and reallocating cropland in favor of crops with high content of nutrients in deficit and high financial returns. Analyzing households' production of nutrients on farm across farming systems could be valuable in guiding intensification strategies of those systems both in market-oriented and subsistence sub-systems and to guide research and development investments. It will also help to identify farm and landscapes niches where interventions could be integrated across rainfall gradients, market opportunities, gender categories and wealth groups. The tool would also be used to establish whether communities in the various farming systems are currently above or below poverty line (1.25 USD per day) with the existing production practices and create production scenarios that could lift these communities out of vicious poverty cycle. In 2014, we made progress in testing our models and tools in terms of assessing the relationships between cropping systems and household nutrient budgets in Gudo Beret site and indicated the nutritional gaps across various household scenarios. The specific objectives of this proposed research project are:

1. Capitalizing on our experiences from Gudo Beret site, estimate the level of malnutrition (particularly children) in terms of energy, protein, vitamins and micronutrients in the various cropping systems of the three AfricaRISING sites across farm typologies;
2. To reach about 800 households with farm-typology based recommendations in cropping mixtures to address household nutrition and income through targeted technologies and practices.
3. To create local capacity of development agents, officers and NARS in farm-level integration required to satisfy human nutrition and income using farm typologies as a planning unit, with emphasis on women and the rural poor including through development of training modules;
4. To establish potential trade-off effects of farm-level integration of system components and reorganization of the cropping systems on livestock feed, water use, soil erosion and labour demand at household scales, across farm typologies.

## Research Method

Following the experiences from 2014, we will develop various farm typologies to identify household nutritional and income levels and develop intensification strategies in three AfricaRISING sites (Basona worenna-Goshe bado, Lemo-Jawe and Endemekoni-Emba hazti). With about 800 representative farmers of various farm typologies, we will collect gap filling household data and capitalize on IFPRI database and other sources in family composition, and consumption behavior across systems and social categories and landscape positions. We will estimate household nutrient budgets per farm typology, establish trade-offs in farm-level integration and establish household strategies per typologies, with various resources base. We will identify commodities that would satisfy nutrition and income needs of farm typologies and promote those through development partners. We will develop training modules for farmers and development partners for scaling farm-typology based practices and interventions.

## Deliverables

Deliverable	Date due
Report on various farm typologies and livelihoods strategies in the various districts (ICRISAT)	Sep 30, 2015
Report on household nutrient budgets, income levels and intensification household objectives across gender groups and wealth categories (ICRISAT/ GAIN)	Feb 28, 2016
Reaching 800 households with farm-typology targeted interventions of improved cropping systems for reducing malnutrition of women and children and increasing income (ICRISAT/ CIAT/ RARIs/GAIN)	Dec 30, 2015
Providing districts with nutritional maps and evidences on nutritional status of households in the various farming systems and the potentials strategies to reverse malnutrition (CIAT/ICRISAT)	Feb. 15, 2016
Report on trade-offs of changing systems on water budgets, soil fertility, labour use (ICRISAT)	April 30, 2016
Report on the relationship between farming systems and poverty, considering the global criteria of poverty-line (1.25 USD per day) (ICRISAT)	May 30, 2016

Deliverable	Date due
Scaling-up methodology and processes to regional research institutes (CIAT, ICRISAT)	April 30, 2016

## Research Outcomes

The anticipated outcome of this study would be:

1. District planners use our farm typologies for targeting and scaling-up
2. Improved household nutrition of communities through altering cropping systems and practices
3. Policy awareness on the link between farming systems and hidden hunger (nutrient insecurity) in Ethiopia at household, community and higher scales;
4. Guideline for development actors to target best-bet crop commodities with higher nutrient density to farming systems in deficit, without radically changing the food habit, market preferences and farmers' choices;
5. Improved local capacity in participatory modelling of cropping systems for improved resource use and food security

## Partners and Indicative Budget, 2015/2016

Organisation	Key contact	Indicative Budgets (USD)	
		Staff	Operational
ICRISAT	Tilahun Amede, Tadesse Gashaw, PhD student	38,500	37,600
CIAT	Lulseged Tamene	10,000	
GAIN (Global Alliance for Nutrition)	Alem Hadera	6,000	
	Sub-total	54,500	37,600
	Admin cost	9,117.85	6,290.48
	Subtotal	63,617.85	43,890.48
	Total		107,508.33

## Title: Chickpea Innovations to Save Crop-livestock Farmers in Ethiopian Highlands from Devastating Effects of Unknown Faba bean disease

ICRISAT

### Theme

2. Field crops varietal selection and management

### Activities Addressed

2.1

### Justification

The Africa RISING project has been promoting legumes, particularly faba beans, in Ethiopian highlands for food, feed, income and intensification of farming systems. However, outbreak of an unidentified fungal disease to catastrophic scales has caused complete losses in the project sites and nationally (Africa RISING Progress Report, 2013: Unpublished), severely limiting production. Furthermore, adoption of improved faba bean varieties in North Shoa zone of Amhara region has been slow as farmers claim poor palatability of the straw by livestock. Faba bean farmers not only require urgent solution to the disease problem; they also need alternative legumes which can fit well in faba bean production agroecologies and chickpea comes in handy here. The potential of expanding chickpea production in the highland areas is high, but largely unexploited. Predominantly grown towards the end of the cropping season on residual soil moisture, chickpea production helps intensify cropping systems by utilizing under-exploited production niches, serving mostly as rotation- and double-crop with cereals, and more as a bonus crop. Chickpea straw is an important feed in the mixed farms, particularly for draught oxen, where grazing land is shrinking due to land degradation, settlements and expansion of cropping area. Readily consumed by nearly all households especially during fasting periods in the form of 'shiro' accompanying 'injera', chickpea is a cheap source of protein (>20% protein), vitamins, minerals and other beneficial phytonutrients. Surplus produce is sold to generate valuable family income for farmers. The ability to fix atmospheric nitrogen and improve soil health further enhances overall farm productivity and smallholder incomes. The fast growth and maturity of chickpea not only improves soil-protective land cover, but also helps break pest, disease and weed cycles in cereal cropping systems. Furthermore, diversifying farm activities with the chickpea reduces risks of catastrophic farm-wide harvest losses prone to occur in cereal systems, contributing to farmers' resilience. Smallholder farmers in the highlands pool together small land holdings to increase the scale and use mechanical planting and harvesting of cereals such as barley and wheat. Therefore, these agroecologies and production systems require early maturing, frost tolerant, herbicide tolerant, machine harvestable and disease resistant chickpea varieties. Research investments in ICRISAT, ICARDA and EIAR have identified superior chickpea germplasm with these traits. ICRISAT is the lead CGIAR center in international chickpea research; out of 24 chickpea varieties, 15 are selections from



ICRISAT material. New varieties that combine early maturity and resistance to fusarium wilt have contributed to an increase in area from about 0.15 million ha to 0.23 million ha, production from 0.14 to 0.40 million tons and productivity from 0.9 to 1.7 tons/ha during the period 2003 to 2013 (Fikre, 2014). Building on these previous successes, we propose to further deploy these varieties to farmers in Africa Rising project sites through on-farm participatory variety selections (PVS) and efficient seed systems.

## Research Methods

We will assemble superior chickpea germplasm including popular varieties and superior advanced lines already identified to have the desired traits (early maturing, frost and herbicide tolerant, machine harvestable and disease-resistant) from ICRISAT, ICARDA and EIAR breeding programs. With farmers identified by officials of the bureau of agriculture in each woreda, we will establish participatory varietal selection (PVS) trials with germplasm of selected traits depending on the agroecologies. Given the low moisture tolerance of chickpea, we will test the feasibility of relay planting of chickpea before, during and after the main season, giving the farmers even more bonus crops. Representatives of value chain stakeholders including farmers, consumers, traders, input suppliers, seed stockists, extension staff, village elders and other opinion leaders will be invited to the on-farm PVS sessions. Participants will be asked to discuss and propose their own selection criteria for best-bet varieties. They will then select line by line and criterion by criterion. The best bet lines will be recommended for promotion and upscaling. The on-farm trials will also serve for seed multiplication for demonstration while seed from the demonstration will be used for scaling up. Seed, being a major constraint in legumes, we will explore innovative ways to establish and institutionalize effective seed systems by integrating with existing seed production and distribution channels of other crops.

## Deliverables

Deliverable	Date due
Assembly of improved varieties, lines and accessions with desirable traits for production in the highlands from ICARDA, ICRISAT and EIAR (ICRISAT / ICARDA/RARI)	30/07/15
On-farm PVS and demonstration of available improved varieties and integrated crop management packages for production in the highlands (ICRISAT / RARIs)	31/03/16
Awareness campaigns conducted through stakeholder/farmer field days (ICRISAT / RARIs)	31/03/16
Chickpea crop and seed production manuals which include integrated pest and disease management prepared, translated into local languages and distributed (ICRISAT / ICARDA/RARIs)	30/06/16
Report on performance of chickpea germplasm and stakeholders' evaluation and selections of best bet varieties for production in the highland agroecologies (ICRISAT/ RARIs)	30/06/16
Report on chickpea seed situation in the highlands and progress made in establishing an efficient seed production and distribution model	30/06/16

## Research Outcomes

- Faba bean farmers devastated by the mysterious faba bean disease find an alternative legume to meet their nutrition, food, feed and income needs and improve their soil fertility
- Farmers identify and adopt high yielding chickpea varieties with desirable attributes for production in the highlands.
- Production niches and agro-ecological challenges to chickpea production in the highland areas identified and potential solutions proposed
- Chickpea introduced to Ethiopian highland agro-ecosystem as a bonus crop for human nutrition, livestock feed, family income, and as a break crop
- Increased overall farm productivity through enhanced land, nutrient and water use efficiency to benefit the farmers.
- Efficient chickpea seed production and delivery options in the highlands by aligning with existing seed production and distribution channels, availing foundation seed, capacity building of existing seed producer groups and innovation platforms (ICRISAT /RARIs)

## Partners and Indicative Budget

Organisation	Key contact	Indicative Budgets (USD)	
		Staff	Operational
ICRISAT	Christopher Ojiewo	30200 (FTE 0.2)	24,000
ICRISAT	Tilahun Amede	7550 (FTE 0.05)	
ICARDA	Seid Kemal	6000 (600@day*10)	
Regional Research Centres	SARI and ARARI		8,000
	Administration cost (16.7%)	7306	5344
	Sub-total	51056	37344
	Total		88400



## Title: Capacity Assessment and Development in Agricultural Water Management to ensure Sustainability of technologies

IWMI

### Theme

7: Knowledge Management, Exchange and Capacity Development.

### Activities Addressed

3. Design solutions that augment rather than replace existing knowledge and practices.

3.2.2. Design processes, tools and media to facilitate knowledge exchange within the CKEGs.

### Justification

Innovations usually bring with it some degree of benefit to its potential adopters, but it equally creates some kind of uncertainties in the mind of adopters (Rogers, 1995). This uncertainty is however reduced by the information embodied in the innovation itself in the form of the possible abilities of the Innovation to solve individual's perceived problems. The goal of the Africa RISING project is to introduce multiple interventions to achieve Sustainable intensification. However, introducing an intervention without understanding the capacity development needs of a particular community may result in lack of sustainability after the project has ended. IWMI has conducted irrigation potential assessment in the existing CRA in all 4 Africa RISING sites and also conducted perception analysis of sustainability. These assessments have brought together gaps in capacity of farmers with specific regards to the following:

- Maintenance of water lifting technologies
- Lack of availability of repair of technologies
- Lack of awareness in irrigation management techniques
- Lack of awareness in storage and use of water.
- Limited implementation/awareness of watershed management approaches.
- Gaps in access to financial resources for irrigation technologies.

Given these gaps it is essential to design capacity development interventions that augment existing knowledge of the farmers as well as give them additional capacity to maintain the sustainability of technologies as well as irrigation practices.

### Research Methods

This activity will work closely with IPS in identifying potential trainers who will be trained to maintain and repair pumps at the Community level. In addition, we will also identify from local partners from Ministry





of Agriculture, EIAR and Universities who are part AR project and build capacity in irrigation management and financial literacy.

## Deliverables

Deliverable	Date due
Need and technology feasibility Assessment in 4 sites	July – August 2015
Assessment of availability and preferences of financial services	July – August 2015
Reporting of Capacity Development Needs	September 15th 2015
Implementing the loan system based on the assessment of Financial Services, Capacity Development for lending institutions on Financial Literacy.	September 2015 to December 2015
Preparation of Tools (Videos, Booklets and Manuals)	October to November 2015
Training and Capacity Development in 4 sites with partners on Irrigation Scheduling, technology maintenance at 2 levels.	December 2015 to March 2016
Distribution of AWM training Tools through IPS	April to May 2015
Post CD assessment	June to August 2016

## Research Outcomes

This activity will build on existing findings with regards technology adoption with particular regards to AWM solutions. A customized Capacity Development manual focusing on Irrigation Scheduling, technology management and best irrigation practices will be developed with farmers and disseminated via IPs. Training will be conducted at two levels, at farmer/household level, and local entrepreneurs will be identified and trained for repair and maintenance of water lifting technologies.

## Partners and Indicative Budget

Organisation	Key contact	Indicative Budgets (USD)	
		Staff	Operational
IWMI	Valentine Gandhi	19500	25000
IWMI	Petra Schmitter	19500	
IWMI	Abby Waldorf	8750	
CIAT	Lulseged Desta	7000	
Mekele University/Partners	Consultant/Trainers	10000	
ILRI	Videographer/Publishing Unit	8000	
Total		97750	

## Title: Integrated R4D approach: Lessons from the field for Sustainable Intensification and Role of effective partnerships.

IWMI

### Theme

7: Knowledge Management, Exchange and Capacity Development.

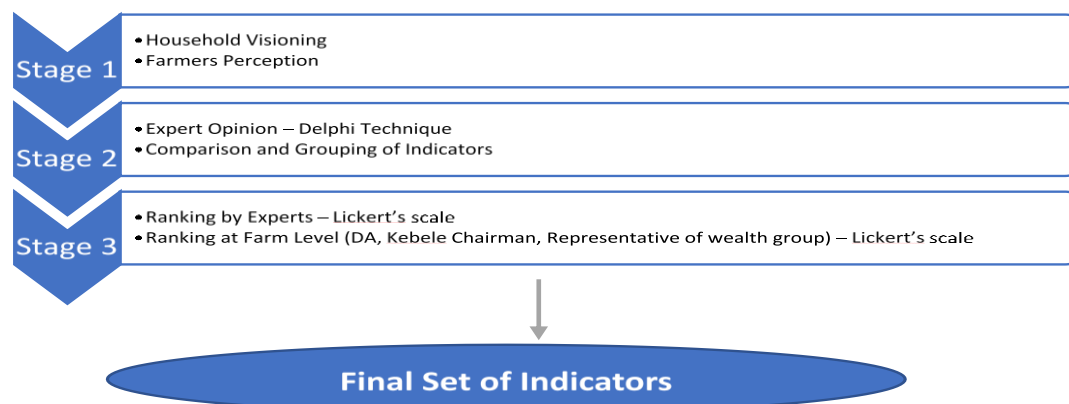
### Activities Addressed

2.1.2. Understand the Concept of Sustainability through Household, community and Regional levels to ensure there is adoption of best practices.

2.1.3. Set of guidelines based on the above to support adoption / scaling.

### Justification

The major goal of Africa RISING is to test whether a cluster of interventions rather than a single approach contributes to Sustainable intensification of small holder farm households. In addition to having effective interventions, it is also essential to understand the perceptions of farmers with regards to technology, irrigation and agricultural practices. In the first year, we measured the perceptions of farmers and scientists in Africa Rising as well as field partners with regards to Sustainability. This was done in the following way.



To improve adoption and ensure sustainable intensification, a good understanding of the knowledge, needs and perception of the farmers with regards to their livelihoods and its coherence with research team members, as well as project definition of sustainability is being developed. Given this project is a R4D project, it is imperative to ensure these findings are translated into a set of guidelines under which all interventions are measured. One of the key factors of success in Africa RISING project is the ability of

partners with different mandates working together for a common goal. However, this comes with a set of challenges, constraints and gaps. These have to be documented as part of knowledge sharing to help us plan effective partnerships in designing collective interventions for small holders.

## Research Methods

The study will expand from the recently concluded perception study and develop a set of guidelines on Sustainability indicators. In addition, a survey will be undertaken on assessing the challenges, gaps and constraints working in partnership in a R4D Project with AR partners and comparison with another similar project (e.g CRPs).

## Deliverables

Deliverable	Date due
Development of Sustainability Indicator Guidelines and Report/Paper	July – August 2015
Survey of Africa RISING Partners and a selected CRP	September 15th 2014
Analysis and Publication of Results	December 2016

## Research Outcomes

This activity will develop a set of sustainability indicators based on triangulation of data as a continuation of the recently concluded study. The activity will also map the challenges involved in partnerships of a R4D project and contribute to better understanding of effective partnerships and resulting interventions that contribute to overall understanding of sustainable intensification and factors involved in achieving the same.

## Partners and Indicative Budget

Organisation	Key contact	Indicative Budgets (USD)	
		Staff	Operational
IWMI	Valentine Gandhi	16250	4000
ILRI	Peter Thorne	15000	
Total		35250	



## Title: Assessing optimal irrigation technologies and practices using a farm system approach

### IWMI

#### Theme

Theme 1: Feed and Forage Development.

Theme 3: Integration of High Value Products into Mixed Farming Systems.

Theme 4: Improved Land and Water Management for Sustainability.

#### Activities Addressed

4.1.3. Evaluate water use trade-offs against other options for irrigable land.

1.1.1. Assess the factors affecting access to water resources by differentiated stakeholder groups.

1.2.1. Develop and implement water access improvement plans mediated via the kebele and woreda level IPs.

1.2.3. Document recommendations for scaling

#### Justification

Small scale irrigation practices are vital to the intensification of crop-livestock mixed farming systems in the Ethiopian highlands. Within the high value crops and irrigated fodder protocols, ICRAF and ILRI have implemented high value crops (avocado, apple) and fodder (oats and vetch) in various Africa Rising sites. In collaboration with ICRAF and ILRI, IWMI has identified water lifting and scheduling technologies suitable for irrigated crop production as function of the available water source. Within different partner projects different sets of water technologies were top-down selected from suppliers based in the capital and different processes for handing over the technologies (either directly to farmers or communities) were utilized. As such a detailed understanding of what processes for handing over and which kind of technologies are more suitable is necessary. Farm surveys have shown that maintenance services for new water technologies are often inadequate and might lead to yield or even crop losses. So far a survey has not been conducted on potential maintenance services within the local settings. Available local maintenance services might be key for achieving sustainability. In many of the sites farmers are involved in multiple irrigation protocols increasing the stress on available water resources. Depending on farmers' preference and water source sustainability, preference is given to specific crops. The water allocation for irrigation at farm system level is complex as domestic and livestock water demands compete with irrigation activities. Furthermore, irrigated crop production is often more input intensive compared to rainfed systems. Inappropriate irrigation management might lead to increased nutrient leaching to

shallow groundwater and surface water sources which on its turn affects human and livestock health as resources have a multi-purpose function. As such, a more detailed understanding on water allocation and quality is needed to assess the optimal irrigation production system within the farm system environment. This protocol will partner with ILRI, ICRAF and ICRISAT in Lemo, Debre Birhan and potentially Bale to: i) quantify the amount of water allocated to the various irrigated crops (fruit trees, fodder, vegetables) at farm level (e.g. farm level water budget), ii) understand farmer preference for water allocation (e.g. trade-off analysis), iii) expand suitable irrigation technologies defined in the testing phase of AR and other projects (LIVES, ILSSI) to other households within sites, iv) assess the impact of irrigation technologies on overall household activities (e.g. gender assessment), and v) assess the organisational and institutional constraints and opportunities for water technology adoption. The effect of irrigation on water resource quality will be assessed at farm level in collaboration with the SWC protocol (IWMI, CIAT) to ensure health safety issues at watershed level.

## Research Methods

The gender suitability of the implemented irrigation technologies in year 2 in Lemo will be assessed using household surveys and focus group discussions. Based on these results as well as the preliminary results of the various irrigation technologies and the wetting front detectors, new farmers will be selected to join the irrigation protocol. The selection procedure will be based on the final suit of technologies offered together with national partners suitable for the prevailing water sources in each of the sites. The farmers selected in the previous year for the irrigated fodder and fruit trees protocol as well as newly identified farmers will be assessed using a holistic farm level approach. The holistic farm level approach aims at quantifying the water allocation for different agricultural practices, domestic and livestock consumption in the dry and rainy season. Additionally, supplementary irrigation in the rainy season will be investigated as function of the crop water requirement and water source to improve system productivity for identified crops in other protocols (e.g. fodder, fruit trees, vegetables, etc.) in combination with water saving techniques. For both cropping seasons a subset of the selected farmers will be given a wetting front detector to optimize water management for the selected crops. Water usage will be quantified for mixed irrigated cropping systems (i.e. with and without optimized water management practices) at farm level throughout the year using a combination of standard field (bio-physical/agronomic) & household surveys, interviews, focus group discussions as well as the continuation of the field book. The sustainability of the farm system will be analysed using a recharge vs. water extraction balance. After each season the households will be evaluated on their water and nutrient management, labour and costs invested into irrigation, task allocation in water extraction (e.g. domestic, livestock, irrigation) in function of their technologies, technology constraint, etc. A review of project documents will be conducted to identify the decision-making process for choosing the different handing over methods as well as the reported results. Identified farmers and communities will be surveyed for feedback on the handing over process as well as their perception on suitability and sustainability. A survey of local services will be conducted to identify constraints of the value chain for finance, supply and maintenance for water technologies taking into consideration staff and logistics, their knowledge and experience with different water technologies as well as their interconnectedness to suppliers higher up the supply ladder. The guidelines for sustainable

upscaling will be based on a combination of literature review on constraints and opportunities of adoption & upscaling of water technologies in Ethiopia and multi-stakeholder interviews (e.g. households, IP members, finance institutions, NGO's, etc.) from different existing projects (Africa Rising, LIVES, ILSSI, IFAD). This will lead to recommendations on the pathways of upscaling small scale irrigation within Ethiopia.

### Deliverables (July 2015-December 2016)

Deliverable	Date due
Preliminary gender survey and analysis with the selected farmers from year 2 on usability, access control and constraints.	August 2016
Identification and Report on additional farmers for irrigation technologies and implementation	August-September 2015
Instrumentation of the selected household for farm system analysis	August 2015
Farmers training on irrigation	September 2015
Farm level water balance (dry season)	April 2015
Farmer evaluation workshop on irrigation	May 2015
Farm level water balance (rainy season)	September 2016
Survey of organisational and institutional constraints and opportunities for water technology adoption	December 2015
Working document on lessons learned from past projects regarding adoption and upscaling of water technologies within Ethiopia	May 2016
Working document on lessons learned from past projects of supplying and financing water technologies to farmers and rural communities	May 2016
Discussion paper/journal article on organisational and institutional factors influencing technology adoption and upscaling	December 2016
Discussion paper/journal article on irrigation for mixed farm systems	December 2016

### Research Outcomes

The protocol will be able to quantify the sustainability of the various irrigation technologies and practices within a holistic farmer level framework. It will identify the trade-offs of water allocation for irrigation vs. domestic/livestock consumption. A detailed understanding of gender-based roles in irrigation will improve adoption rates of the various technologies which, on its turn, in combination with the institutional analysis yield to the identification of upscaling implementation pathways with national partners. Lessons learned from handing over processes and their suitability for different technologies will be identified for further upscaling. A value chain approach for supplying water technologies will be identified for recommendations on the suitability for supplied technology choices as well as consideration for the wider higher-level needs for sustainability.

Furthermore, the quantification of optimal water allocation and its effect on nutrient leaching for mixed cropping systems will yield valuable information for the watershed assessments done in the soil and water conservation protocol. As such a more holistic view is gained on the sustainability of irrigation at watershed level.

## Partners and Indicative Budget

Organisation	Key contact	Indicative Budgets (USD)	
		Staff	Operational
IWMI	Petra Schmitter	39000	90000 (field visits, irrigation technologies, survey and sample analysis)
IWMI	Valentine Gandhi	19500	
IWMI	Kai Wegerich	35000	
IWMI	Simon Langan	9000	
IWMI	Research Officer IWMI (60 days)	6,000	
IWMI	Local Research assistants (1 per site/ 700\$/month for 18 months)	37,800	
ILRI (Through Irrigated Fodder)	Melkamu Kindu	Please refer to Budget in the respective protocol	
ICRAF and Partners (Through High Value crops protocol)	Aster	Please refer to Budget in the respective protocol	
Total			236300



## Title: Supplementary furrow irrigation of high value crops using Tractor mounted motorized pumps

IWMI

### Theme

4. Improved Land and Water Management for Sustainability

### Activities Addressed

Identify and test appropriate and sustainable water management solutions to address those niches (linked to the activities of Themes 1 - 3) in crop rotation framework.

### Justification

Irrigated agriculture has been on the rise in recent years in the rainfed agricultural systems of Ethiopia both as a means for livelihood diversification and a climate change adaptation strategy. Abstracting, conveying and applying irrigation water is an important component of the total production cost in irrigated agriculture and affects the profitability of the irrigation technology and thus the economic incentives to farmers. Motorized pumps mounted on and powered by small multifunctional two-wheel tractors (Figure 1a) can be used to abstract and convey water to farm irrigation sites. As these tractors can also be used for land preparation, post-harvest operations (Figure 1b) and transport, we hypothesize that this type of mechanized irrigation is more adoptable for smallholders than mechanized irrigation using pumps powered by their own engine. On the irrigation sites, irrigation water can be applied through furrows between raised planting beds (Figure 1c), which is more efficient than flood irrigation on a flat surface. Raised beds can be shaped using a simple tool-bar based furrower (Figure 1d) pulled by the same tractor used to power the motorized pump. Raised bed also brings a number of benefits such as reduced seed rates and increased access to the field for weeding and fertilizer application.

Generally, crop and water productivity and profitability can be increased as a result of supplementary irrigation. However, the profitability of mounted motorized pumps in relation to the capital and operational cost of the technology is unknown for the Ethiopian Highlands. Also, the optimum amount of supplementary irrigation for high water productivity and economic profitability is not established. This protocol proposes to fill this knowledge gap.



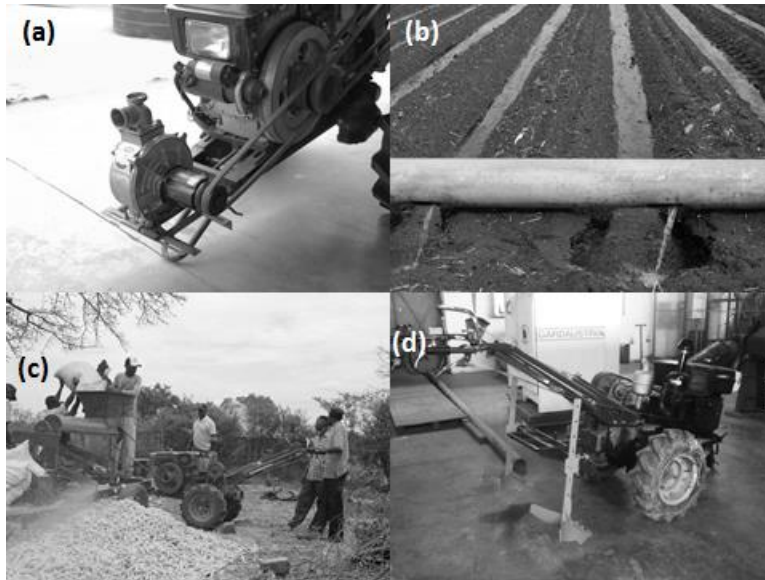


Figure 1: (a) mechanized pump mounted on a two-wheel tractor; (b) furrow irrigation; (c) maize sheller powered by a two-wheel tractor; and (d) furrower mounted on a two-wheel tractor.

## Research Methods

The implementation of this study is subject to training of service providers, and farmers and development agents by CMMYT to operate the tractor and the pump on their own to do the land preparation and water abstraction. IWMI will be leading the implementation of the trials and is responsible for collection of all the agronomic and water management related data using a similar approach as in the irrigation protocol. The study will be conducted in the three Africa RISING project sites (Lemo, Sinana and Debre Birhan). Farmers' fields with sustainable water access for irrigation purposes will be identified at each site. The selected farmers will prepare their land and plant two (potato and faba beans) crops using furrows, following the agronomic practices of the crops. Each crop will be planted on a 100m<sup>2</sup>. Irrigation water will be applied using the furrows and the timing of irrigation will be guided by Wetting Front Detector (WFD) that will be installed on each plot. The quantity of water applied, the time required to irrigate the plots, fuel consumed, number and gender of labour required for irrigation and other farm operations will be recorded using field books.

The water requirement of the crops at the four growing stages and the amount of irrigation water applied during each stage, agronomic performance including biomass and yield of the crops, and water productivity of the crops will be determined. The economic profitability of each option will be analysed using standard profitability analysis techniques (cost benefit analysis) and compared to the other water lifting technologies assessed by IWMI in the irrigation protocol. Participatory demonstration and evaluation of the technologies will take place during field days, in conjunction with other Africa RAISING activities.

## Deliverables

Deliverable/Activities	Date due
Selection of suitable plots and participating farmers	October, 2015
Training of farmers	November ,2015
Land preparation and procurement of seeds, fertilizers	January, 2016
Planting of potato and Faba bean with irrigation	February, 2016
Harvesting of the crops	May, 2016
Progress report on the dynamics of smallale mounted motorized pump irrigation	June, 2016
Report detailing the productivity and economic profitability of the options	September, 2016

## Research Outcomes

- Information for use by local communities, extension agents and policy makers on the role of tractor mounted motorized pumps on productivity and profitability of crops grown during the belg season to achieve sustainable intensification.
- Irrigation guideline for potato and faba bean in each of the sites.

## Partners and Indicative Budget

Organisation	Key contact	Indicative Budgets (USD)	
		Staff	Operational
IWMI	Valentine Gandhi	6,500	40,000
	Teklu Erkossa	39,000	
	Petra	6, 500	
	Research Assistant	12,600	
	Sub total	64,600	
	Total		104,600
CIMMYT	Fred Boudron	20,000	
ICARDA	Seid Ahmed	10,000	
CIP	Kalpana Sharma	10,000	
	Total		157,600

## Title: Enhancing the productivity of enset system through Integrated Disease and Pest Management (IPM) approaches

### Theme

Theme 5. Improving the Efficiency of Mixed Farming Systems through more Effective Crop - Livestock Integration.

### Activities Addressed

- 4.1.1. Identify options for improving tool hygiene
- 4.1.2. Test the impacts of improved tool hygiene methods
- 4.1.3. Review adaptation options with participating farmers
- 4.2.1. Review treatment options for bacterial wilt
- 4.2.3. If feasible test promising options on-farm

### Justification

Enset (*Ensete ventricosum*) is a food-security and high value crop in the southern and Oromia regions with increasing trend of expansion to other parts of the Country. The crop is a means of food, cash, feed, medicine, sources of fuel wood and other products and services for small holder farmers. It is an important intensifier of production systems given its compatibility with fruit crops, spices, planting materials and other crops when grown in association. Currently, the productivity and area coverage of the crop is declining due to various biotic and abiotic factors. Diseases such as bacterial wilt (*Zanthomonas campestris* pv. *musacearum*), pests (Enset root mealy bugs, leaf hoper, mole rat and porcupine) and soil nutrient depletion are some of the important production constraints of the crop in its growing localities. It is reported that up to 80% of Enset farms are currently infected by EXW, which directly affects the livelihood of more than 20 million enset growing farmers in the country. The effect is severe in less fertile soils. The traditional Enset processing practice for various products (Kocho and Bulla) is another challenge associated with Enset production, which is labour intensive and a workload for women. An action research initiative is proposed on Enset and its production system as the production constraints are repeatedly mentioned by farmers, development actors, researchers and policy makers in the southern region; there is evidence that EXW is reducing Enset yield and quality; loss of a single Enset plant in a family would mean loss of one man's feed; production constraints have relevance across Enset growing regions; Enset is a women's crop; and there are best bet Enset production technologies and practices.

## Research Methods

### Part 1. Baseline survey

Very quick baseline information will be collected in two Africa RISING research kebeles (Jawe and upper Gana) to document production and utilization constraints, and existing experiences among men and women farmers. There will be a also review and synthesis of the available information. The baseline survey will mainly focus on assessments of bacterial wilt transferring agents, disease prevalence across soil fertility gradients, traditional community seed/planting material supply system for enset clones, suitability of tissue culture planting materials across different farm types, assessment on diversity of enset clones and indigenous disease and pest controlling practices and , production systems. A total of 40 representative farm households will be selected and interviewed in the two kebeles.

### Part 2. Studies on existing enset production systems

Group discussions will be held with local farming communities in the two Africa RISING research kebeles to select representative farms for more in-depth quantitative studies. A total of 10-15 farms per kebele will be selected based on landscape position and socio-economic characteristics of the communities. Detailed studies will be conducted on diversity of enset for different use value, value chain (production to marketing), soil management practices and feed assessment (possibilities to intercrop leguminous forage crops, nutritional analysis of the enset for feed).

### Part 3. Introduction of integrated interventions (disease tolerant and high yielding enset varieties; soil fertility management options)

A total of 3-4 varieties will be introduced and tested both at farm level and Farmers' Training Center (FTC) sites. At farm level, 15 male and female farmers per kebele will be selected and provided 10 suckers for each of the variety. Selection of farmers will base on landscape position and socioeconomic condition. Sex-disaggregated baseline information of these farmers will be collected and documented. The farmers will have the option to select varieties based on their need, preferred characteristics and resource availability (land). Planting can be 2m x 2m. Farmers can also plant the varieties in a scattered arrangement depending on their interest. The 3-4 varieties will be also demonstrated at the FTC sites in a block arrangement and will be replicated three times. Morpho- agronomic and yield data will be collected. More detail assessment of the varieties will be carried out at the FTC site.

Soil fertility will be measures across the Enset Gradient (from home to the outfield) and Wealth gradient along with introducing soil fertility management options (Zai pits, Potassium application and Micronutrient).

### Part 4. Community based integrated disease and pest management

A farmers' field school approach will be used to train 50 farmers per kebele (100 farmers for the two kebeles) during the rainy and dry seasons. The subject of the training will be mainly on management of EXW and other pests. The composition of the trainees will be men and women farmers, model farmers, farmers who own EXW infested fields, DAs, KAs, school director, local institution leaders and other influential community members and decision makers at the woreda level. The training will focus on

improved enset production packages. The kebele and Woreda IPs will be a champion in community mobilization and information dissemination. The training will be supported by posters, manuals, videos and other resource materials. How the disease transmits through different agents and the disease controlling methods will be practically demonstrated to the trainees.

## Deliverables

Deliverables	Date due
Survey report	August 2014
Sex-disaggregated data base on enset preferences, utilization and production constraints	Aug. 2014
Clones suitable for different use value will be identified	September 2014
Knowledge materials (poster, briefs, video clips, digital stories, publications)	September 2014
Capacity building of farmers, development agents and extension –report	End of August 2014 and February 2015
Value chain actors for enset will be identified	Oct-Nov 2014
Existing seed system on enset and role of gender on enset production will be identified	September 2014
Soil fertility management options suggested	November 2015
Submit 1 proceeding and 1 journal publications	December 2015

## Research Outcomes

- Less incidence of bacterial wilt and mealy bugs in AR Sites and beyond
- Benefit at least 5000 farmers in SNNPR
- Institutional capacity to manage complex pest and disease incidences
- Improved productivity of Enset systems
- Farmers food security and income will be improved through the disease and pest reduction and awareness creation on resources management interventions
- Change of roles of men and women
- Introduction of enset varieties that are disease resistant and preferred by men and women, IPM practices that are labour efficient and appropriate to households of different SE characteristics

## Partners and Indicative Budget

Organisation	Key contact	Indicative Budgets (USD)	
		Staff	Operational
Areka Agri Res Center	Zerihun Yemataw		Baseline – 3000
Hawassa UNV	Bizuayehu Tessfaye		Studies on existing prod systems- 25000
Bioversity	Guy Blomme		

Organisation	Key contact	Indicative Budgets (USD)	
		Staff	Operational
ILRI	Kindu Mekonnen/Annet Mulema/ Aberra Adie		On-farm and FTC – 20000 Training- 10000 Total = 48000
Woreda and Zonal Office of Agriculture	Belayneh Osire/ Tamrat Aerjno		
ICRISAT	Tilahun Amede		
CIP	Schulz Steffen/ Jogo Wellington		
ICRAF	Aster Gebrekirstos/ Aklilu Nigussie		
	Total		