RESEARCH PROGRAM ON Dryland Systems

CGIAR

CGIAR Research Program on Dryland Systems

East and Southern Africa Flagship 2014 Performance Monitoring Report

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Food security and better livelihoods
for rural dryland communities

The CGIAR Research Program on Dryland Systems aims to improve the lives of 1.6 billion people and mitigate land and resource degradation in 3 billion hectares covering the world's dry areas. Dryland Systems engages in integrated agricultural systems research to address key socioeconomic and biophysical constraints that affect food security, equitable and sustainable land and natural resource management, and the livelihoods of poor and marginalized dryland communities. The program unifies eight CGIAR Centres and uses unique partnership platforms to bind together scientific research results with the skills and capacities of national agricultural research systems (NARS), advanced research institutes (ARIs), non-governmental and civil society organizations, the private sector, and other actors to test and develop practical innovative solutions for rural dryland communities. The program is led by the International Centre for Agricultural Research in the Dry Areas (ICARDA), a member of the CGIAR Consortium. CGIAR is a global agriculture research partnership for a food secure future.

For more information please visit:

drylandsystems.org

I. CRP PERFORMANCE MONITORING REPORT FOR CALENDAR YEARS 2014 AND 2015

1.1. PREAMBLE

CRPs produce two main categories of reports[1]:

(i) Detailed documentation on progress at research theme/location/component and sub- component level to CRP leadership. This information is the foundation that establishes the credibility of the reports in category (ii). It is prepared by CRP staff and submitted to the CRP leadership and is an important reference for (ii).

(ii) Annual performance monitoring report at CRP level, from CRP Director and Lead Center to

Consortium Office

[1] A CRP can also produce an annual report of activities to communicate to a large audience and donors. This is entirely voluntary and up to each CRP. Such annual reports are therefore not part of these templates.

1.2. TEMPLATE FOR REPORTING

A. KEY MESSAGES

- Baseline has been conducted in Ntcheu District which gives insights on what are the major issues from both irrigators and non-irrigators.
- Baseline has also been conducted in 3 irrigation Schemes in Mozambique.
- Focusing on one research site offers an opportunity for integration of research in a systems manner.
- One of the main opportunities was being able to leverage on the work that development partners such as Total LandCare have been working on for a number of years. This leads to greater impact for the Dryland Program.
- Operationalizing a systems approach does require an investment in time and resources and very clear systems conceptual framework.

- The ICRAF activities in East Africa focused on two topics. Resilience in drylands was addressed by the publication of a book that reviewed the resilience provided by trees in drylands systems. The resilience issue was also addressed through a publication on the potential and uptake of remote sensing in insurance. The second topic revolved around development of rural economies through the scaling of techniques to improve land health and agricultural, better access to markets and value chains and the strengthening of farmer based institutions in semi-arid systems where the DGIS DRYDEV project is implemented. The above activities resulted in the following key messages: There is significant resilience to be gained from the promotion of trees and the development of index based insurance in drylands agricultural systems.

Synthesis Brief description of any noteworthy re-orientation in the CRP

- A baseline survey was undertaken to assess and characterize agricultural biodiversity (ABD) and dietary diversity (DD), including resources conservation, availability and use, diversity, markets, consumption and diets in four Extension Planning Areas (EPAs) of Ntcheu district-Malawi within the Chinyanja Triangle. The survey involved expert discussions with district agriculture and extension officers, 14 focus group discussions in selected target sections and, a household survey of 340 households to collect and gather data, as well as relevant livelihoods information, comprising the extent of agricultural biodiversity managed by these households and the dietary diversity consumed by women and children within them. The survey data have been entered and are currently being cleaned and analyzed.

A synthesis of the two most significant achievements/success stories in the year (gender disaggregated where pertinent), with references to associated evidence and website links for more details.

There are clear cases of individual farmers sustainably intensifying their agricultural production using agricultural water management practices. The important thing is further understand who is intensifying, their risk profile and gender? This will help inform what needs to be done for up and out scaling.

Diffusion of Sustainable Intensification Knowledge is one of the interesting case studies. The pioneer of irrigation in one of the schemes in Ntcheu had worked on an irrigated farm in South Africa and upon his return he then set up treadle pump irrigation before upgrading into a river diversion with more community members joining the irrigation scheme.

Activities done for the year 2014 continued to establish baselines for IDOs 1 (resilience), 2 (wealth and wellbeing), 4 (Natural resources management) and 6 (capacity to innovate) and strides have been made to scale out best- bet technologies towards contributing to the above IDOs. Socio-economic surveys covering 312 households within the three countries of the Chinyanja Triangle (CT) were conducted. Key information captured include data on types and amounts of food consumed by the household, knowledge and use of existing land management and agricultural practices as well as resource endowments. Generally, results showed that most people in the region are poor earning below the poverty line (average of USD 230 per year). The use of soil and water conservation technologies is also quite low. The majority of farmers use inorganic fertilizer compared to 'environmental friendly' organic fertilizers. In terms of the three countries, results indicate that land holding size is small in Malawi compared to Mozambique and Zambia, which is because the population density is high in the former. Because of this, the majority of the people in Malawi are engaged in off-farm activities with an average earning of USD 163 per year as compared to USD 68 in Mozambique and USD 84 in Zambia. Survey results also showed that there are differences in literacy levels between the studied countries, where an average of three members per family in Malawi can read and write, followed by 2.3 in Zambia and 1.5 in Mozambique. Though we cannot make conclusions based on such one-off survey the possible reasons could be that free education system influenced the situation in Malawi while the long-time war in Mozambique may be responsible for the lower number of family members exposed to education. A greater number of households in Zambia and Mozambique own fields that do not require inputs while the majority of Malawian farmers' fields are poor and require input. Technology use is quite variable with most Malawian farmers using different inorganic inputs compared to those of Mozambique and Zambia who employ fallowing and crop rotation. Data on food production and land management was also captured using an agronomic survey conducted in Malawi, Linthipe site on co-located plots/households for which there is soil and socio-economic information. Results showed that half of the farmers obtain yield below the attainable/potential levels. While most of the findings were acceptable there are some observation such as a negative and significant relationship between maize yield and extension service that need further investigation. Considering the current situation and the fact that own produce is the major source of food, farmers need other sources of income or should intensify production to fill the gap.

After the above overall situation analyses, we have reached out large number of farmers to demonstrate integrated soil fertility management (ISFM) and good agronomic practices in two Districts of Malawi. Six participatory demonstration plots (mother trials) were used in achieving this. Each mother trial had two bean varieties (either climbers or dwarf beans), each planted in three replicates, with fertilizer, animal manure, cropping system and staking options randomized within each replicate. About 38 female and 8 male farmers participated with additional technology demonstrated and disseminated on 49 plots. The study integrated beans, a dominant protein in the region, in maize cropping systems. Yield from some of the climbing beans (mother trials) demonstration plots was higher than the long term national average by 189%. Farmer managed 'baby trial' plots also showed 50% yield difference compared to adjacent control plots. Gender dis-aggregated participatory technology selection was conducted where farmers were asked to choose the best and least performing plots among the various treatments. This was an exciting exercise which enhanced understanding of the corresponding reasons for the different performance levels and sharing of experiences on improved management and agronomic practices. Through participatory trainings, demonstrations, field days and exchange visits, it was possible to directly impart best farming practices

among participating (30 farmers) and indirectly benefited some neighbouring communities (120 farmers).

Among the key successes, introducing new bean varieties which are generally resilient to drought and disease attracted great deal of interest from the community. The significantly high yield observed in the mother and baby trials also raised the demand for seed that led us to increase our coverage to around 200 farmers (2014/2015) compared to that of about 50 farmers in 2013/14. Our ISFM demonstration also created awareness among the farmers that yield of beans can be significantly increased by applying appropriate inputs and agronomic practices while their traditional 'belief' was that inputs are meant for maize and other commercial crops.

The study also demonstrated the need for integrated approach in tackling maize yield gap among smallholder farmers. Mixed-effect models employed to assess the effects of soil, agronomic and socio-economic factors on maize yield also revealed interesting results. Among the soil determinants boron was the most significant factor that affected maize yield gap between different households. Though additional data will be needed to confirm, this finding is interesting as micronutrients such as boron as often neglected during fertilizer recommendation. Among socioeconomic factors, it was interesting to observe that extension, group membership and number of years a household head was involved in farming decision making affected maize yield negatively. Cross-analysis of the co-located data showed that socioeconomic factors play significant role in maize yield through influencing farmers' willingness and ability to adopt new technologies. Further analysis of the additional data acquired recently will help clarify and confirm some of the results.

Multi-stakeholder platforms (innovation platforms) advanced as forums for knowledge exchange, learning and capturing opportunities, to improve productivity and market orientation of crop livestock systems: through IPs we developed options for systems improvement in context and at different scales, stakeholders gained capacity by participating in IP processes, including new institutional arrangements, partnerships and technical packages. Future research should explore socio-ecological structures that hinder change processes, for more effective and inclusive for sustainability outcomes.

In Zimbabwe, the IP in Nkayi has re-discovered groundnuts as potentially highly profitable crop. This has led ICRISAT in collaboration with the government of Zimbabwe, and supported by Research Program Grain Legumes, to start a national initiative to revitalize the groundnut industry, aligning improved seed systems with improved crop management and value chains.

We are advancing our research on legumes as critical farm sub-component for crop livestock integration: While the use of legumes in mixed systems contributes significantly to livestock feed systems, increased household nutrition and potential market income, farmers increasingly benefit also from soil management. Legumes fulfill the different objectives of sustainable smallholder agriculture, critical option for sustainable intensification. As culturally a women's crop, legumes also make a significant contribution in addressing the gender specific objectives of dryland systems research.

B. IMPACT PATHWAY AND INTERMEDIATE DEVELOPMENT OUTCOMES (IDOS)

C. PROGRESS ALONG THE IMPACT PATHWAY

C.1 Progress towards outputs

Gender and Irrigation: Its implications on Sustainable Agriculture Intensification. The case of Ntcheu District, Malawi

Gender and Irrigation: Its implication on Sustainable Agriculture Intensification in the Chinyanja Triangle

Drylands Project on Gendered Land Tenure & Water Infrastructure in the Chinyanja Triangle

Baseline Study in the Chinyanja Triangle (Malawi)

Baseline Study in the Chinyanja Triangle (Mozambique)

Gender policies in Mozambique and their implications for sustainable intensification of agriculture in Mozambique

Developing Fit-for-Purpose Transboundary Water Cooperation: Options for the Shire Catchment

SRT1: Approaches and models for strengthening innovation systems, building stakeholder innovation capacity, and linking knowledge to policy action

Output 1.2: Enhanced capacity for innovation and effective participation in collaborative IAR4D processes

ICRISAT has adopted "Innovation Platforms" (IP) approach to engage all relevant stakeholders in the work at action sites both in Eastern Africa and Southern Africa. IPs were formed for selected research for development theme or value chain and through IP activities followed up on site specific development pathways, based on actors long term visions, selected high potential value chains for short term benefits, technical interventions for sustainable intensification and institutional support (figure 1). However, the composition, activities and operational methods varied from one IP and to the other.

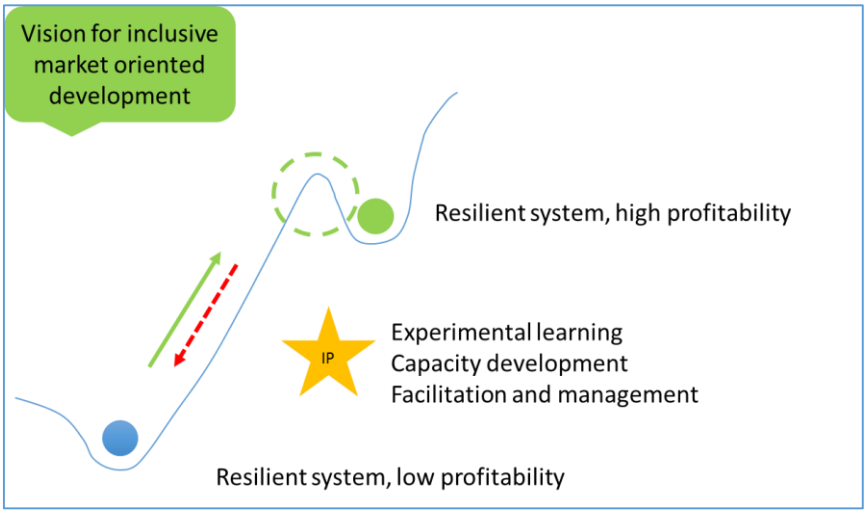

Figure 1. Conceptual framework for enhancing resilience and profitability in smallholder farming systems through innovation platforms (modified from van Rooyen et al., 2013).

<u>Analyze household typology, technology use and coping strategies in the Chinyanja Triangle</u>

Detailed household survey was conducted with 312 households to understand the overall household typology and assess if there is spatial variability. Socio-economic survey tool was prepared and survey conducted in at least three example districts of the Chinyanja Triangle (Malawi, Mozambique, and Zambia). Results show that the majority of the people in the region is poor earning below the poverty line (average of USD 230 per year). The main sources of income in the region include sale of crop and

animal products, causal labour and small trade. Average attainment of formal education in the region is 5±3.6 years with a few having post primary and post-secondary qualifications. Usage of soil and water conservation technologies is quite low in the region. Farmers use box ridges (37.39%), contour ridges (33.9%), vetiver grass (9.13%) and mulching (6.06%). Other technologies such as rain water harvesting, enclosure, basins and ripping are less common.

Results also show that land is scarce in Malawi with an average of 0.32 ha per individual while in Zambia and Mozambique land to man ratios are slightly larger with averages of 3.9 and 1.4, respectively. Off- farm incomes are relatively large amongst Malawian farmers with an average USD 163 per year as compared to USD 68 in Mozambique and USD 84 in Zambia. Dependency ratio is higher in Mozambique with 2.59 members belonging to the active group of age between 16-65 years against 3.38 for age <16 &/or >65. Literacy levels are high in Malawi with an average of three members per family who can read and write, followed by Zambia and Mozambique with an average of 2.3 and 1.5 members per household who can read and write, respectively. A greater number in Zambia and Mozambique own fields that do not require inputs while the majority of Malawian farmers' fields are poor and require input. Technology use is quite variable with most Malawian farmers using different inorganic inputs compared to those of Mozambique and Zambia who employ natural methods of fallowing and crop rotation.

Main coping strategies in the region include doing ganyu for cash or food (food for work during critical food shortage period), selling livestock, consuming immature crops and taking smaller portions or skipping meals. Additional analysis results will be presented using the new dataset as well as categorizing by country and site. A report that characterizes the CT is available at WEL-website.

Entry points and research strategy

Analysis of biophysical and socio-economic data shows that the majority of the population in Chinyanja Triangle is poor, has limited access to inputs and level of technology adoption is limited. This implies that there is a need to improve livelihoods through improved resources management and agricultural productivity. Results and field observations also show that there is spatial variability in the above attributes among the different countries, sites and plots. A basic approach to improve food security is thus introducing and demonstrating integrated soil fertility management (ISFM) and sustainable land management (SLM) options that consider the specific conditions of sites. In this study major emphasis was given to ISFM, where a mother-baby trial arrangement was used to introduce new bean variety and input use to enhance productivity and yield of cereal-legume intercropping. Details of results of such intervention are reported below.

Assess yield gap and identify agronomic, socio-economic and biophysical constraints

Measuring the yield gap between farmers can help understand the causes of the difference in crop yield. Agronomic survey tool was developed to estimate maize yield at replicated plots and record associated agronomic practices. In addition, socio-economic survey tool was used to collect detailed information on household attributes, resources endowments, resource management practices, technology adoption and use. These data are geo-located with other detailed soil and landscape health data collected earlier. This made it possible to assess the impacts of biophysical, agronomic, and socio-economic factors on maize yield gap. Maize was selected for the survey because it is a staple and dominant crop in the region. Additional agronomic (244 plots) and socio-economic (214 households) surveys were conducted in 2014 for two sites and data are being analyzed. The sampling design was based on the land degradation surveillance framework (LDSF) where plots and households were co-located to plots where LDSF was conducted.

Basic analyses results show that maize yield range between 0.4 to 10 t ha^{-1} averaging 4.1 t ha^{-1}. There is wide yield gap between farmers and the mean yield was much lower than the potential yield for the varieties used. Modelling the major determinants of the observed yield gap by integrating biophysical, agronomic and socio-economic factors shows that yield is influenced by differences in farm, household's characteristics as well as corresponding agronomic and management practices. Generally, higher yields were associated with farmers who used improved varieties and applied inorganic inputs using the 4R approach and chicken manure as organic source. Farmers who applied NPS (23:21:0 +4S) had 1.25 t ha^{-1} higher yields than those who did not apply. Weeds significantly reduced yield by 0.81 t ha^{-1} from low to higher weed cover rating. Overall gaps in yield between farmers were also results of differences in wealth status, engagement in off-farm employment, period making farming decisions and access to agriculture advice. For example, resource constrained households (e.g., limited livestock and asset possession) were associated with a yield decline of about 0.08 t ha^{-1}. Households whose members are not engaged in engaged in off-farm employment tend to have lower yields by 0.69 t ha^{-1}. Results also show that extension, group membership and number of years household head made farming decision affected maize yield negatively. Further correlation and cross-analysis showed that resources constrained farmers did not follow proper agronomic practices (e.g., weeding, plant spacing) and did not apply fertilizer. Similarly, households with more members within active age group have higher yield by 0.42 t ha^{-1}. Among the soil nutrients, boron and nitrogen play key role in determining maize yield in the study site. Details of data collection methods and analyses results are presented in a publication and manuscript submitted for publication.

Conduct participatory cereal-legume agronomic trials and identify best-bets

Under the research domain of "*Improving Agricultural Intensification in the Maize Mixed Farming Systems*" of the Africa RISING Project, cereal-legume integration using new bean varieties and soil fertility management trials were set up in Kandeau (Ntcheu) and Linthipe (Dedza) sites of Malawi. The major aim was to improve the productivity of beans, which are the major sources of protein for poor people. To achieve this, 1) cereal-legume agronomic survey tool was designed; 2) five new bean varieties were introduced, 3) participatory ISFM practices aimed to enhance productivity of those varieties were implemented in a participatory manner, and 4) the performances of the varieties under different management practices and environmental conditions were evaluated. The trials (so called Mother-Baby trials) were implemented by farmers with joint technical support from CIATs BEAN and SOILs programmes.

Results show that yield from the main demonstration plots of climbing beans (mother trials) was higher than the long term national average by 189%. On the other hand, farmer managed 'baby trial' plots showed 50% yield difference compared to adjacent control plots. Analyses of variance (ANOVA) results showed that pure bean stand with stick stakes and chicken manure produced significantly higher yield (1961 kg ha^{-1}) whereas beans intercropped with pigeon peas as live stake produced low mean yield (741 kg ha^{-1}). Maize and bean intercrops supplied with NPK and/or manure also produced high yield. In addition, varietal response to ISFM technologies and cropping systems were significantly different. Climbing bean variety DC86-263 produced the highest yield under maize + NPK + manure cropping system (2451 kg ha^{-1}) whereas MBC33 was highest in pure stand under stick stakes + manure application.

In order to exchange experiences and lay the ground for further dissemination as well as out scaling, participatory evaluation of the performances of the mother trials were undertaken in Linthipe (Dedza) and in Kandeu (Ntcheu) sites. Gender dis-aggregated participatory technology selection was conducted where farmers were asked to choose the best and least performing plots. Among the various treatments, bean + maize + NPK was selected across gender groups while bean + stick stake + unfertilized treatment was the least preferred. For DC86-263 variety, both men and women preferred

the bean + maize + NPK + manure as plant stand had higher survival and vigor. The maize + NKP + agroforestry system received mixed reaction from men but women rejected it. Overall, this activity was very successfully executed and had high level of excitement and support of the participating farmers. It also enhanced understanding of the corresponding reasons for the different performance levels and sharing of experiences on improved management and agronomic practices. Through participatory trainings, demonstrations, field days and exchange visits, it was possible to directly impart best farming practices among participating (30 farmers) and indirectly benefited some neighbouring communities (120 farmers). Data for the 2013 and 2014 seasons have been collected and detailed analysis repot is submitted to Africa RSISING bilateral project. A manuscript is also under preparation.

In East Africa a methodological framework has been developed for assessment of agricultural biodiversity and dietary diversity at community and household levels (Indicator 4).

For the action site East Shewa, the overall aim of the IP is sustainable intensification of the agricultural systems. The work is in progress at two locations. The first location is in Adamitullu woreda in which the much of the proof of concept work is undertaken and the second location is Boset woreda where scaling up opportunities for proven technologies are being tested. The scaling up work is part of a major development project lead by ICRAF under DGIS project. At Adamitullu the IP includes CG institutions (ICRISAT, ILRI, ICRAF, CIAT and ICARDA), national research institutions (EIAR, OARI), Woreda and Kebele level agricultural extension officers of Bureau of Agriculture (BoA), NGOs (International Development Enterprises – IDE, Valley Children and Women Development Organization – RCWDO, Serve Ethiopia Development Association – SEDA), private for profit organizations (Admitullu Pesticide Company and micro financing company) and representatives of farmers. ICRISAT is facilitating the IP operations. Extensive discussions were held during the IP meetings to identify major constraints faced by farmers and identify options for addressing the same (Table 1). The IP participants have identified the following constraints in the target areas and actions required to address the same. The formation and operationalization of IP has helped in pooling the resources and in implementing the activities through collective action by harnessing the synergies. This helped in achieving higher outputs and outcomes.

Table 1: Constraints identified and activities planned to achieve sustainable intensification in Adamitullu by partners in the innovation platform.

Constraint	Actions required	Responsibility
Degradation of the land and water resources	Control excessive runoff	IDE-Ethiopia
	Area exclosures and afforestation	BOA- identify members of closed area, compile their interests and supply seedlings
		OARI to provide transport
		Farmers to provide labor
		ICRISAT to provide implements
	Construct check dams and contour bunds	IDE-Ethiopia through its ongoing activities
		ICRISAT to monitor costs and benefits
Managing impacts of variable climatic conditions	Conduct critical analysis of dry spells and their impacts	ICRISAT in collaboration with OARI to compile and analyze the historical climate data and conduct ex-ante analysis
	Water harvesting and smallscale irrigation	IDE to implement farm ponds
		ICRISAT to monitor water flows
Enhance productivity	Explore intensification through intercropping on at least 20 farmer fields	ICRISAT to test maize-pigeon pea intercropping system
	Introduce and promote use of improved varieties on at least 20 farms	ICRISAT, EIAR, OARI and BoA
	Improved fertility management through legume intensification	ICRISAT, EIAR, OARI and BoA
Better characterize the baseline conditions	Conduct household surveys covering about 300 households covering different gender groups	ICRISAT, OARI, IDE
Capacity building	Identify capacity development needs of farmers and development agents (SWC, Crop management, farming as business, etc.)	All
	Develop appropriate programs that include experience sharing, demonstrations and trainings	All
	Identify appropriate partners	All
	Implement selected activities	

Gwanda and Nkayi IPs in Zimbabwe

IPs at these sites prioritized improving biomass production and feed quality, to address dry season feed shortages and to sustain livestock flows to markets as the most important issues for strengthening the crop-livestock systems. They identified and used participatory technology development approaches to promote the technologies and develop local capacities. The identified initiatives to address these constraints included crop diversification with dual purpose maize, sorghum and cowpeas and forage legumes (sunhemp, mucuna, *dolichos lablab*), on-farm demonstrations on local seed production, agronomic practices (organic fertilizer, using manure and maize-mucuna rotation) and livestock feeding.

The IP in Nkayi had re-discovered groundnuts as potentially highly profitable multi-purpose crop. Subsequent value chain analyses confirmed a wide gap between demand and low levels of production. The processing industry in Zimbabwe imports 90% of the requirement from the neighboring countries. In 2013, the value of groundnut imports into Zimbabwe from Malawi was valued at USD 3 Mio. About 40% of Zimbabwean households grow groundnuts, but productivity is extremely low. Main reasons are lack of improved varieties (since 10 years no varieties have been released), absence of viable seed system, poor agronomic practices and disconnect along the entire value chains. ICRISAT, through CGIAR Research Program on Grain Legumes launched a national initiative in partnership with government and private sector to revitalize the groundnut industry in Zimbabwe. Critical entry points identified for large scale groundnut production and sale were: 1. Establishment of the seed sector: release of improved varieties and local seed multiplication through on-station and on-farm research; 2. Developing capacity: NARS, extension and farmers are engaged in participatory variety selection, demonstrations on agronomic practices, developing structures for local seed multiplication, 3. Establishing market linkages: new partnerships between breeders, seed growers and farmers are being forged, as well as between farmers and the food processing industries 4. Fostering crop livestock synergies through on-farm research; Research / NGOs play a key role in facilitating the linkages. The IPs also recognized the role and contribution of groundnut in improving women's incomes and household nutrition. In a gender assessment women and men farmers confirmed that market and technology development will not reduce women's control over this crop, but empower families to increase profitability using available land.

Marara-Tete IP in Mozambique:

The focus of this IP is on market oriented livestock production, and involved three complementary key activities: 1. Land ownership to establish long term security and commitment: through partnership with Aceagrarios the IP itself was legalized as AAPACHIMA association with title to the Marara market place and adjacent rangeland (13,359 ha); this provided a new institutional structure to the IP, which is now more committed to this place and can become more organized. The Mara IP is entitled to apply for funds and can become formal partner. 2. Develop social capital: interactions at the IP (workshops, reviews, technical trainings, market exploration) created trust among actors, brought new linkages (e.g. to private sector, NGOs) and technical knowledge towards more proactive planning; 3. Promote crop-livestock technologies: based on locally identified training needs, and in partnership with IIAM Research Station in Angonia we developed tailored training and demonstrations on biomass enhancing technologies, piloted a local forage bank for mucuna and forage tree multiplication as potential source of income. Farmers raised issues that small grains are most reliable in dry years, but markets poorly developed. They see potential for irrigated horticultural crops for generating income.

Manica IP in Mozambique:

The overall focus of this IP is on market oriented production of common beans. Actors believe that the combination of improved accessibility coupled with increased production will sustain collective sales in large quantities. To unlock this potential in collective marketing of common beans the IP prioritized 1. Facilitate government investment in road infrastructure: this is beyond research but links to government programs can source investments and thereby improve access to input and output markets; 2. Facilitate initiatives that strengthen collective action: We demonstrated cases of false certified bean seed and encouraged farmers to use government services to control seed quality; as part of market exploration farmers were exposed to input suppliers and buyers of produce; partnerships were sustained with local NGOs as brokers for large scale bean sales; 3. Promote crop-livestock technologies: training packages were designed and implemented through on-farm demonstrations on bean production to market and draft animal management; having few draft animals farmers overuse these and undermine their reproductive potential.

Lessons:

- The IP approach to involve relevant stakeholders in diagnosing problems, exploring opportunities and investigating solutions was found to be very effective. This helped in pooling skills and resources and achieve greater impacts by harnessing synergies.
- Comparison of IP activities across sites illustrates that the diversity in farming systems requires development of options in context. IPs will serve as an important means to achieve this.
- Systems improvements require interventions at different scales, technical interventions at local scale and market and policy at higher scale. Often, some critical issues such as improved infrastructure in Mozambique, or land legalization are beyond the capacity of research and development institutions. Engaging multiple stakeholders at different scales and with broad backgrounds through IPs helps in addressing the constraints in a holistic way.
- Flexibility in managing IP processes is required since important actors, e.g. private sector, often don't attend IP workshops, but still have critical interest in the process.
- There is a need to better understand the effects of underlying socio-ecological structures that prevent change to take place, and what mechanisms in an IP can make change processes more effective and inclusive.
- While IPs have become a popular instrument for research for development, we conclude from our experience, that there is need for research to improve the effectiveness in IP operations and stakeholder inclusion for sustainability of outcomes.

SRT2: Reducing vulnerability and managing risk

Output 2.1: Combinations of institutional, biophysical and management options for reducing vulnerability designed and developed

SRT3: Sustainable intensification for more productive, profitable and diversified dryland agriculture with well-established linkages to markets

Output 3.1: Sustainable intensification options designed and developed SRT 3:

Through a critical analysis of biophysical factors and following systems approach, site specific baskets of low- risk and highly productive innovations that make optimal and sustainable use of available resources were developed and tested for achieving sustainable intensification of crop livestock systems in the target areas. Evaluation of the identified technologies was carried out by conducting on-farm and on-station experiments by engaging farmers, extension agents and researchers from NARS.

Adamitullu East Shewa:

Based on the analysis of data on biophysical conditions, discussions with farmers and other stakeholders, a number of interventions were identified as potential technologies for sustainable intensification of agriculture in the target area. The identified interventions fall under three major groups. Activities aimed at reducing degradation and rehabilitating degraded lands, activities that improve productivity and profitability of the farms and activities that contribute to increased income. This area receives rainfall during March – April period, locally referred to as *Belg* season and during June to September period known as *Kremt* season. *Belg* season is short with low rainfall (200 mm) and high variability (>50% CV). Much of this rainfall is not utilized since farmers limit the cropping to *Kremt* season which is more dependable with low risk. Rainfall during this season is about 450 mm rain with less than 30% coefficient of variation. Based on the trends and variability in rainfall along with results from crop simulation modeling, we have identified two interventions. The first one is to utilize the *Belg* season rainfall to grow a green manure crop for enriching the soil or to grow a legume crop that can be used as fodder. The second one is intercropping with slow growing long-duration legume during the *kremt* season to make better use of higher rainfall and longer season. Farm ponds were identified as another important intervention to harvest runoff water and use it for growing high value crops. Area exclosures was identified as the main intervention to rehabilitate the degraded lands. Few other interventions such as improved livestock management and capacity building were also identified and the same will be

implemented during early 2015 as a preparation for 2015 season. A summary of the proposed activities and achievement to date is in Table 2.

These studies have highlighted the need for government support especially for initiatives such as farm ponds, access to credit for purchase of seed of improved varieties and other farm inputs and access to markets in case of new crops such as pigeon pea. The promotion of various interventions has also led to increased demand for credit as per the requests received by micro-finance Company.

Table 2: Technological interventions identified for sustainable intensification of smallholder agriculture in Adamitullu

Objective	Activity	Achievement
Arrest degradation and rehabilitate degraded lands	Construct conservation structures and check dams	About 46 farmers have levelled, terraced their land and dug contour trenches on a minimum of 0.5 ha land
	Afforestation of degraded lands	Area exclosure was initiated on about 100 ha land by planting about 6000 seedlings by about 75 men and women farmers
	Strengthening bunds with grass/tree plantations	About 10 farmers planted pigeon pea for strengthening the bunds and another 20 farmers planted fodder species
Increase productivity	Promote adoption of improved varieties	24 farmers received 25 kg seed of improved Haricot bean on rotation and planted the same
		Farmers availed loans arranged through microfinance company for buying improved seed
	Introduce crops and cropping systems that make best use of available resources	20 farmers tested the intercropping option with pigeon pea
	Increase legume component in the systems	Planned for 2015 crop season
	Construct farm ponds and promote small scale irrigation	23 farmers dug field tanks of 143 m^3 capacity
Increase income	Promote cultivation of high value crops	23 farmers grew vegetables such as onion and tomato using harvested water
		About 46 farmers have planted fruit trees such as mango and avocado
	Introduce improved livestock management practices	Planned for 2015 crop season
	Introduce apiculture	Planned for 2015 crop season

Zimbabwe

In Zimbabwe, demonstration of identified interventions was carried out in two ways:

1. Technology packages tailored to the requirements of different farm types: A total of 160 farmers implemented the technologies, with 18 farmers being closely monitored for subsequent model calibration.
2. Continuation of food feed crop and forage demonstrations, started in 2012/2013 season. A total of 66 farmers participated. A group of 16 farmers produced biomass for feeding cattle (n=39), another group of 30 farmers produced biomass for feeding goats (n=75). The feed experiments are ongoing; results will be shared and profitability of different feed ratios revised at the IP.

3. A third group of 20 farmers multiplied dual purpose sorghum, mucuna and sunhemp seed. The seed producing farmers had produced excess seed that was later distributed to 1,920 farmers across the two districts, in response to the demand expressed during field days and by extension. Through the IP we will further investigate the market potential of forage seed, among smallholder farmers as well as to other private sector and development organizations.

Crops and livestock are important sub-components of the farming systems; yet there are trade-offs on biomass use. On-farm trials focused on comparing biomass use for organic fertilizer and/or livestock feeding. Trials were set up in three districts, Gwanda, Nkayi and Matobo. Previous rotation trials have shown that maize/sorghum following velvet bean (*Mucuna pruriens*) in rotation has higher yields and lower weed and termite infestations compared to continuous maize/sorghum or even maize/sorghum-cowpea in rotation. During the 2014/15 season we expanded different soil fertility trials, with 66 farmers. The crops included dual purpose sorghum, maize and cowpeas, *mucuna, dolicos lab lab* and sunhemp. Three treatments included inorganic fertilizer at 200 kg/ha application rate for both basal and top dressing, organic fertilizer at 4000 kg/ha manure, crop rotation), and no fertilizer as control. Data on crop yields and biomass production were collected during the seasons; the analysis is ongoing.

Feeding trials conducted during the 2013 dry season demonstrated the cost-effectiveness of using home-grown legumes (especially Mucuna-based rations) as a substitute to commercially produced and traded supplements in goat and beef feeding systems. The trials were continued in the 2014/15 season, with 46 farmers, feeding a total of 118 cattle and 188 goats during the dry season (September-December). The animals were fed different mixtures, with 66% crop residue from a cereal crop (sorghum/maize) and 33% forage legume (mucuna/sunhemp/lab lab). The animal weights were monthly monitored; the analysis is ongoing.

During the 2014/2015 season we also started work on conservation agriculture incorporating fodder production, in Manicaland and Masvingo provinces. Demonstration sites were set up with by 12 farmers. Performance of crops (sorghum, groundnuts, maize, and mucuna) is compared for conventional management and conservation agriculture with different fertilizer treatments (micro-dosing, recommended rate, control). Data collection and analyses are ongoing.

Improving groundnut production through on-farm trials was taken up in the 2014/15 season as part of the groundnut initiative, supported by the Malawi groundnut breeding program, Research Program Grain Legumes. Smallholder farmers in Nkayi and Tsholotsho, together with NARS technicians and district level extension, were trained in seed multiplication of the available variety Nyanda, on-farm agronomic trials (plant population trial, weed management trial, time of planting trial, CA trial, ridges vs flap planting trial) and participatory variety selection (Chitala, Ilanda, Baka, Kakoma, Chimhandara, Landrace). First observations on crop establishment suggest that dry spells soon after planting affected crop emergence; poorest emergence was for CG7. Rodents and cutworms damaged the crops. Continuity of extension support was a challenge, frequent absence affects the trial results, e.g. as farmers waited for advice before weeding. Other observations are that bringing in lessons from Malawi and Zambia was an eye opener to Zimbabwean farmers and created much interest in both groundnut research and production. Agronomic practices however differ across countries, Zimbabwean farmers were not familiar with the Malawi ridge planting; there is need to demonstrate and evaluate the advantages of higher seed densities. Land is still available; Zimbabwean farmers indicated interest to expand land for groundnut production, once stable markets are provided.

Mozambique

Risk is high in Changara, Tete province and agriculture is more extensive. Farmers focus on livestock; most farmers own at least some goats, biomass is a critical constraint. Farmers diversify cropping systems (pearl millet, sorghum, maize, groundnuts, other legumes), but lack technical knowledge and access to inputs and services, resulting in very low crop and biomass yields. Following IP priorities, the project engaged in a partnership with IIAMs Angonia research station to enhance the capacities of farmers and extension services, through on station and on-farm demonstrations on food feed crops and feeding. In 2013/14 30 farmers participated, representing farm types with different resource endowment (resource poor, stepping up, intensifying). They choose different technology packages, including combinations of dual

purpose crops (drought tolerant maize, sorghum, cowpea, groundnuts, and pigeon pea), forage legumes (mucuna) and grasses (annuals and perennials). Parallel to the demonstrations, mucuna was multiplied on a local seed bank. Low rains, and lack of continuity in support by extension and NARS affected the results. Under low rainfall yields were relatively good for Mucuna, sorghum and pigeon pea; maize, groundnuts and cowpeas had poor yields. Farmers managed to harvest mucuna surplus, which was purchased back by the project for the 2014/15 season, also to sensitise for forage seed as cash crop. Pigeon pea was largely eaten by livestock. Farmers' prioritized crop rotation for organic fertilizer effects, as inorganic fertilizer seems too risky. Lack of biomass feeding technologies were demonstrated but experiments could not be done.

The demonstrations were repeated during the 2014/15 season. Due to scattered settlements the extension and supervision process was adjusted, with one place as central learning place and farmers clustered by farm types. The most important criteria for selecting crops was food security. Even though Maize was not suitable for the agro-ecological conditions, all farmers ranked maize as highly preferred crop. Different farm types choose different technology packages, female and male farmers ranked the crops differently, better off farmers preferred high value crops while poor resourced farmers and women farmers preferred food crops. According to local practices most farmers plant the crops dry and without spacing, to save labour. They mostly use retained seed and OPVs. They mix the seed, to minimize the effect of total crop failure.

The approach of participatory technology development and demonstrations was adjusted to the priorities in Manica, with higher agro-ecological potential. 30 farmers participated in the 2013/14 season; technology packages included improved common bean varieties following market criteria, inorganic fertilizer application as compared to manure and crop rotation, mucuna production and improved crop management, especially spacing. While for some farmers improved common bean varieties performed better than local varieties, others discovered that the certified seed was false. The issue of impurity of certified seed was raised to provincial seed services. The need to improve linkages to input suppliers, purchase inputs collectively was of high priority, especially fertilizer, since manure is short due to limited livestock numbers. Samples of newly emerging pests were sent for analysis.

At both sites NGOs requested mucuna seed multiplication for the next season, at 2 USD/kg Mucuna seed.

Lessons

- Ex-ante analysis has indicated a large potential for increasing the productivity and profitability of the farming systems in East Shewa. However, large scale adoption of these practices depends on access to inputs, credit and markets.
- Farmer participation in technology testing is critical for promoting technologies; Mucuna became an attractive crop for fodder, soil fertility and income generation, as farmers observed that the crop was less susceptible to drought and pests attack
- Farmer to farmer extension enhanced farmer interest to increase areas under fodder production
- Testing technology packages with farmers of different profiles is a way to better understand constraints and priorities in crop production, e.g. labor shortage, risk perception, management implications

SRT 4. Anticipating and measuring impacts and cross-regional synthesis

4.2: Baseline characterization of livelihoods and ecosystems, and synthesis across regions of lessons learned about the options developed in SRTs 2 and 3

Adamitullu-East Shewa:

In Eastern Africa, transect from Marsabit in Kenya to East Shewa in Ethiopia representing a gradient of climate and land use systems has been identified as "Action transect" for dryland systems research (Figure 2). Annual rainfall in the transect varies from as little as 200 mm in the south to about 900 mm in the north with some pockets receiving more than 1000 mm. Land cover follows the climate gradient from bare sparse vegetation in low rainfall southern part of the transect to crop lands in the high rainfall areas in the north. Within the transect work is in progress at three action sites, two sites (Marsabit in Kenya and Borana in Ethiopia) represent the pastoral systems and the third site (East Shewa in Ethiopia) represents the intensive rain fed system.

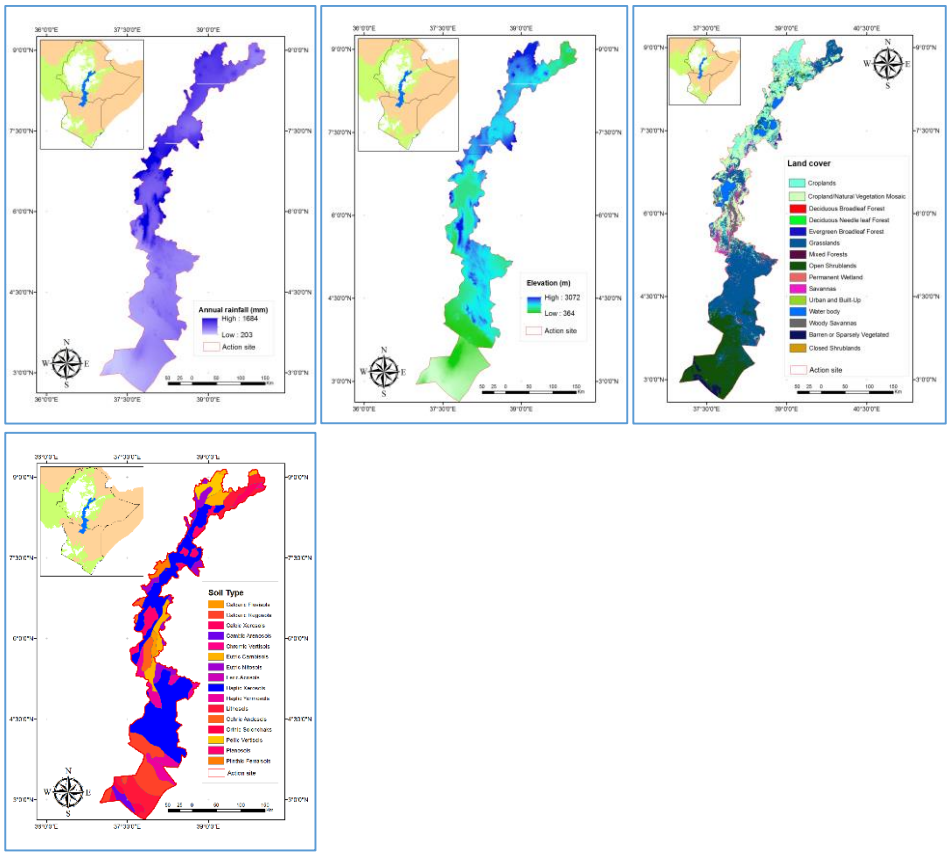

Figure 2: Eastern Africa action transect showing gradients in rainfall (a), elevation (b), land cover (c) and soil type (d).

The action site of Adamitullu covers Dodicha and Haleku G/B kebeles. Haleku G/B is a flat land while Dodicha is surrounded by hills. Nearly 68% of the land in Haleku G/B is under rainfed agriculture while only 22.9% of the land in Dodicha is cropped.

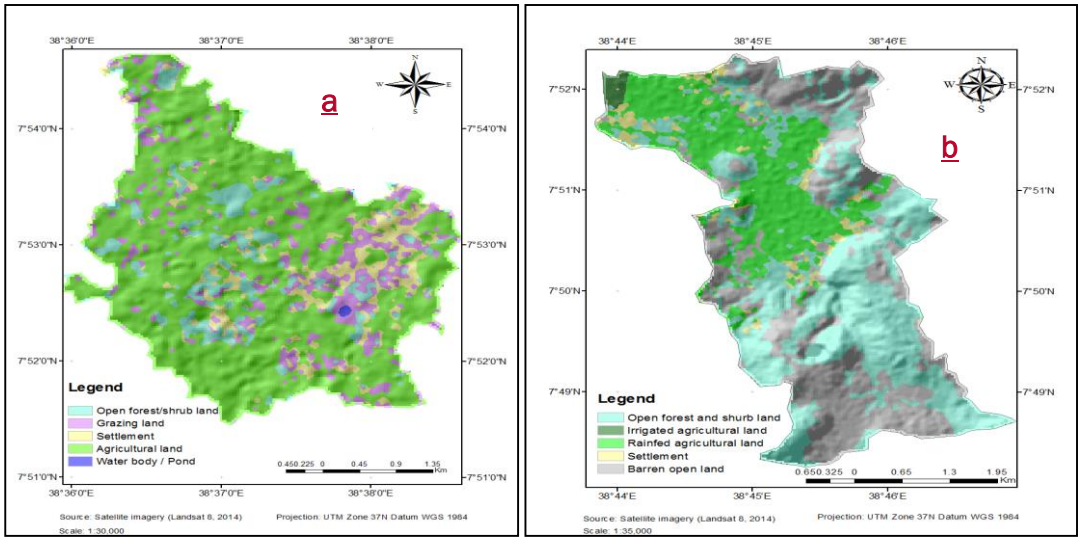

Figure 3: Land use in the two kebeles Haleku G/B (a) and Dodicha (b)

Baseline surveys were conducted in both Dodicha and Haleku G/B Kebeles where implementation of various activites aimed at sustainable intensification of smallholder farms is in progress. The survey covered a total of 301 households of which 106 (35%) are women headed households. Significant differences were observed between men and women headed hoseholds. In both Kebeles, a large number of female household heads are illiterate, have smaller family size and own small holding compared to the men headed households (Table 3). In general, total income of women headed households in Dodicha is less than 50% of the men headed households while in Haleku G/B it is nearly 70%. Men headed households have higher proption of their income coming from agriculture and livestock compared to women headed households. Differences were also observed in the way men and women ranked variosu

constraints to agriculture. High cost of inputs is rated by most wome as the most important constraint faced by them. A more detailed analysis of the data is in progress.

Table 3: Comparision of some important characteristics of female and male headed hopuseholds

Characteristic	Dodicha		Haleku G/B	
	Female	Male	Female	Male
Number of households	49	103	57	92
No education (%)	87.8	24.3	84.2	14.1
Household size (no)	4.83	6.58	5.13	6.43
Land size (ha)	0.83	1.03	1.69	2.76
Cattle	1.77	3.26	3.16	4.42
Sheep & goat	2.32	3.11	3.05	2.16
Chicken	1.84	1.90	2.05	5.15
Oxen	0.80	1.39	1.53	2.13
Total Income	4538	9447	11758	17030
Agriculture	1716	5304	5865	11274
Livestock	923	2292	1987	3663
Sale of other products	321	488	1083	584
Remittances	315	242	1638	206
Casual employment	147	339	239	105
Business	116	136	217	135

Mozambique

In Mozambique typologies were used to further assess how farmers with different resource endowments can participate in overall development pathways: Most farmers face cash constraints and find it difficult to reinvest in agriculture. Especially female headed households in Marara require safety net support to build up their assets. Stepping up households are often younger. In Manica they have double the land than the resource poor and some more livestock. They sell a lot of beans already; business with beans is an opportunity for them to build up their livelihoods. In Marara these young households are often absent for off-farm work. To sustain their family needs they sell quite a number of livestock. Improving bean and livestock marketing conditions is critical for improving the livelihoods of young families. At both sites the most successful farms are those that are capable of diversification, in this case investing in and integrating both crops and livestock. They show that crops and livestock are pathways to enhance profitability and earn more income, potential where the system can go to, where people with more land and livestock sell more. These farmers play an important role to engage with the private sector for improved market arrangements, test and promote alternative technologies. Engaging farmers with government and private sector towards a common goal is a way to build trust and change behavior, and empower women and men farmers in the process.

To understand the resilience levels of communities and types of households we developed a resilience index, through interviews with the same households as in the baseline survey. The index was based on farmers' self-perceived scores of resilience, for 4 resilience domains (learning to live with change, systems diversity, access to multiple sources of knowledge and self-organization) and in terms of various farm sub-systems. At both sites, farmers expressed preparedness to change their agricultural activities in order to

explore new opportunities, especially new sources of off-farm income, in Marara with greater emphasis on livestock production and in Manica on crop production. Less confidence was on marketing. Preparedness to change was stronger in Manica than in Tete, possibly reflecting higher agricultural potential and less risk of this area. However, we found a dichotomy between farmers' preparedness to change, and having access to the relevant knowledge. At both sites farmers scored access to multiple sources of knowledge as lowest. They gave very low scores for diversity in terms of collective action, off-farm activities, and marketing. Across the sites the resilience scores reflect weaknesses in market development and collective action, which prevent farmers from tapping on the economic opportunities in the region.

Efficiency analysis illustrates high potential to reduce inefficiencies in the production of goats (Changara, Tete) and common beans (Manica, Manica), as some farmers produce efficiently, but the majority does not. Options to increase production efficiency were identified as adequate allocation of extension support to improve crop production through better crop-livestock integration (draft power, manure, and feed), livestock production (health, feed, and housing), practical exposure to improved management and better dissemination of relevant information.

Preliminary legume value chain analyses, in Zimbabwe and Mozambique show common features: The value chains are largely informal and short, with scattered farmers, poorly connected to input suppliers and few agents until groundnuts/beans reach final consumers. Options to sell to more distant markets are not well explored; they often depend on mediation by research and development organizations. Women dominate production and whole sale of groundnuts and beans. Disconnect between functional seed systems and grain value chains restrict farmers from increasing production. Partnerships between farmers, small and medium seed houses and processing enterprises, supported by government services and development programs are critical to catalyze the development of the sub-sectors.

In Tete and Manica, soil samples were collected from purposely selected farmer plots (39 in Manica and 31 in Tete), in fields with different years under cultivation. The results from soil sample analysis are expected by end of January 2015. Fertilizer application was confirmed as extremely low, less than 10% farmers apply fertilizer irregularly and mainly for gardening; fertilizer use for dryland crops was rare. Fertilizer use was much less in Tete, with higher rainfall variability and frequent droughts. The most common reason for not using fertilizers was that it would burn the crops, especially in the Tete. Other reasons were long distances to shops selling fertilizers; lack of financial capital and poor knowledge on fertilizer use.

4.3 Fodder and forage production capabilities of different dryland habitats assessed and mapped

Zimbabwe

Full biomass assessment was done for Nkayi and Gwanda districts in Zimbabwe. Both districts receive annual rainfalls of less than 450 and 650mm, persistent droughts affect especially crop production, and imply feed shortages for livestock. The objective of this assessment was to estimate biomass and quality, to identify options for increasing livestock feed. To estimate available feed, biomass sources were classified into four land cover classes, woodlands, fallow lands, grass lands and fields. Rapideye satellite images from 2013 were analyzed in ENVI software. To confirm the land uses participatory GIS was carried out. In each land use class, biomass composition was assessed, in Nkayi quarterly in 2013 and 2014, in Gwanda 2014. The samples were weighed in the field during the survey for wet mass, and then oven dried for 24 hours in the laboratory at ICRISAT to obtain the dry weight, upon which sub-samples were collected for further analysis of the nutritional values.

In Nkayi District woodland were the largest in area size (188 579 ha), followed by fallow lands (139 672 ha), while grasslands and fields were less (58 352 and 42 792ha respectively). In general, across the land cover classes, the weight was higher for palatable species (85% of dry weight) than for non-palatable species (63%). Palatable species were also more diverse. Fallow lands had the greatest diversity of palatable species, followed by fields. Woodlands had more unpalatable species. Feed nutritional quality, as the nutritional composition of palatable species, in terms of ash, moisture, crude protein and crude fibre, was analysed for May 2013, during the peak of the growing season. The average CP (Crude protein (CP) - n%*6.25) content was 9.7% for grasses and 19.3% for forbs, including Acacia and mucuna. At this

time, forbs provide more than the required 8% CP for livestock maintenance, as compared to the dry season when grasses lignify and the CP content goes down to 1-2%. The in-vitro dry matter digestibility was 50 and 60%, fairly high for both grasses and forbs.

For Gwanda District the analyses of satellite images, biomass and feed quality are outstanding.

Drylands resilience: One book, two briefs and one conference presentation on the resilience provided by trees in the drylands of Eastern Africa. Two Evidence on Demand Reports requested by DFID on Trees and Livelihoods respectively Trees and Watersheds in Karamoja, Uganda. One research paper on the potential and uptake of remote sensing in insurance.

DGIS Ethiopia. Characterization studies, policy reviews, analysis of value chains, RS and GIS analysis & baseline studies in advanced stages will be available in 2015 to guide project implementation. Extensive dialogues with farmers, local level government sector offices, MFIs, researchers and service providers and also partners took place, to identify quick win activities, reviewing progresses, to develop year 2015-18 country plan. Stakeholders, extension services and institutions in the each country were mapped. Partners' capacity needs were assessed, reviewed, analysed and addressed which assisted implementation capacity gaps of the partners. The project has also done capacity building, training and organized workshops on exchange and learning to project partners, policy makers, farmers, women and youth.

DGIS Kenya. 1. Characterization study. Biophysical and socio-economic characterization done in six sites (2 in each of 3 counties) in Kenya and drafts reports available to be finalized in 2015. 2. Quick wins. Six sites selected with and up-scaling domain outlined based on the watershed approach. Several quick wins interventions tested to inform the implementation phase as follows; water harvesting technologies such as zai pits, sunken beds and retention ditches; drought tolerant crop seeds introduced such as sorghum, green grams, pigeon peas and cow peas as well as capacity building exercises on market-based interventions. 3. Agricultural practices– a study on agricultural practices was conducted as part of the characterization studies and it has been included in the planning for the main implementation phase. Report is being finalized 4. Support to farmers. Sensitization on watershed management and the need for communities to safeguard it. Communities agreed to form water resource users associations (WRUAs) and develop sub catchment management plans and also review the existing ones, and manage their catchment areas. 122 groups were selected with a total of 3502 beneficiaries of which 1042 men while 2459 Female. The groups were further capacity built and identified areas for improvement as they continue to implement. 5. Stakeholders and capacity needs assessment– Mapping of stakeholders has been done and that of related projects to leverage on overlay on google platform. Capacity needs assessed only for farmer organizations. 3 trade fairs conducted that reached over 1800 farmer participants, 72 service providers and honey products, poultry, goats, fruit juices and tree seedlings. Rapid assessment of a honey processor, market champion, was conducted and the capacity development package done in Waita (one of the sites). 6. Scaling institutional approaches– discussions held with county governments in the project area on collaboration and scaling out activities. The project model was being shared with other stakeholders in government, FAO and NGO sector for testing application

C.2 Progress towards the achievement of research outcomes and IDOs

Significant progress was made towards IDOs 2-6 in the action site. The main focus is on IDO 2 and major constraints to achieve this IDO and interventions required to overcome the same were identified and field testing and demonstration of the same is in progress. The increase in productivity and income observed with test farmers is expected to contribute for increased access to food and also diversity. Under the farm ponds 20 farmers are cultivating vegetables and fruits which will contribute to the improved nutrition. The

interventions aimed at conserving water and land resources are improving the soil conditions and there by enhance sustainable utilization of the same. Targeted involvement of women and other gender groups is increasing their access to information, credit and inputs. Various formal and informal training programs implemented have made the participants better understand the systems; improve its productivity and profitability.

Household typology, technology adoption and coping strategies

The available comprehensive socio-economic dataset and analysis results can be used by Flagship members within the CT triangle and beyond. For example, the 'Livelihood and systems analysis' workshop planned in Malawi in February 2015 will make use of the dataset. CG centers in the region as well as partners such as Total Land Care, LUNAR University and other existing or new projects will also use the dataset to facilitate making informed decisions. Currently, the background data and report is being used by the BMZ-funder CIAT project in the Ntcheu district of Malawi. In the coming year's detailed analysis of integrated biophysical and socio-economic data will help understand the complex land use decisions, adoption constraints and provide guide towards achieving eco-efficient agriculture through sustainable intensification.

Yield gap and identify socio-economic and biophysical drivers analysis

The paper published for Babati (Tanzania) has created awareness and discussion about yield gap, associated drivers and possibilities to address the observed gap. It also identifies the areas where further research is needed. The paper under review, which is focused on the Dedza district of Malawi, will create similar discussion on yield gap and specifically associated socio-economic drivers. Since this paper integrated agronomic, biophysical and socio-economic factors that affect yield gap between households, it can form key reference material for discussions related to yield gap. Up-coming report based on dataset for neighbouring districts (such as Ntcheu in Malawi) can provide information on the spatial variability of yield gap and the associated drivers. Local partners (government organizations, NGOs, development organizations, Universities and CG centers) will use the reports and papers as references, planning and support decision making.

Cereal-legume agronomic trials on farmers' fields and identify best-bets

The analysis results of the performances of bean varieties depict differences in response of under mono- verses inter-cropping systems and usage of manure and fertilizers. The results contribute to the multi-locational adaptation and selection program by South Africa Bean Research Network and are more likely going to support release of high yielding climbing varieties by the Department of Agricultural Research in Malawi under the National Bean Program.

Data collection on existing crop and food diversity available to local communities in Ntcheu district (Malawi) is complete. The data is undergoing further analysis. **Data will be made available as an open access database in 2015 (Indicator 7).**

Drylands resilience. There has been significant uptake of the Treesilience book describing the resilience provided by trees as demonstrated in the research uptake report submitted to DFID. The information that was compiled has also been used to write Evidence on Demand reports commissioned by DFID to be used to support the design of a DFID development project in Karamoja, Uganda.

DGIS Kenya / Ethiopia. The five year DGIS DRYDEV project started in 2014 with a full one year inception phase. This inception phase has been used to do characterization, including reviews of agricultural

practices, analysis of value chains and enabling policies, identify capacity building needs in order to prioritize the agenda of DRYDEV for the period 2015 – 2018.

C.3 Progress towards Impact

IMWI work in both Malawi (Ntcheu) and Mozambique the research was conducted in areas where NGOs are working with farmers. The NGOs included Total LandCare for both Malawi and Mozambique. This meant that our research was directing practical development activities being conducted by development partners such as Total LandCare.

Though recording tangible and quantifiable impacts and outcomes of interventions in such short time is not easy, the above outputs and results show that there is tangible progress towards success. With some of the findings above, our understanding of important processes has improved and over time will facilitate realizing outcomes and impacts. Because of success observed in the first year of introducing new climbing and bush bean varieties, the demand has raised and we are currently working with over 200 farmers. The tools have been designed such that gender disaggregated data collection and analysis can be possible.

D. GENDER RESEARCH ACHIEVEMENTS

Gender was successfully incorporated in various research approaches:

The baseline surveys conducted tried to capture the needs and requirements of different gender groups. A third of the sample surveyed covers women headed households. Significant differences in the size of land holding, income and productivity were observed between households headed by men and women. There are also differences in the constraints faced by these groups and the planned interventions took this into consideration.

Engaging women in innovation platforms is one way to harness diversity and explore alternative lucrative opportunities in a traditionally maize-cattle dominated farming system. And besides boosting income, it also improves women's confidence. As one woman in Zimbabwe put it, "It's about my self-esteem. I want to be seen at a sale pen as a powerful woman." A women in Mozambique said "We farmers are now engaged in a common vision. We have a voice to express our needs, to partners who bring knowledge to us".

Extending the use of the tool on women's' control over crops and livestock improved our understanding of the relationships between men and women farmers and the possible impact on these relationships given the interventions planned: In Zimbabwe, both women and men felt a positive change as women have been gaining control, result of husbands working off-farm and women more empowered and in leadership positions through experience and technical training. Importantly that decisions on use of the income generated from crops and livestock are made together. Legume and small stock value chains are important for women to generate income, apart from nutrition and soil fertility benefits. Solutions that look at improving rural access to inputs, relevant information about production technologies and marketing will be an important way of helping women farmers. We can also illustrate that market and technology development has not reduced women's control over legumes or small stock. On the contrary, with better access to markets, higher prices, greater exposure to market processes (assembly, weighing observation, price setting etc.) and complementary technical trainings, women and men can now better sustain a regular supply of produce to the market, gaining real tangible benefits.

Farm typologies illustrated that female headed households are often among the resource poor and vulnerable. However they are equally found among the most successful farm households, who diversify and intensify their systems. In participatory development of technology packages we assess

women and men's perception on the feasibility and advantages of different crops and management styles.

The baseline survey was sex disaggregated which enabled the collection of gendered information on the interviewed households. This is an important step since a better understanding of the community we are working with will enable better targeting of development interventions which will result in a greater gender sensitive impact.

A study on the matrilineal was conducted to have a better understanding of the matrilineal society in Ntcheu which has implications on access to resources such as land, water, forestry and also influences access to services such as education and extension

In addition to the detailed socio-economic data covering sites within the three CT countries, gender disaggregated data was collected for two sites in Malawi including one in our action site (Ntcheu). The revised survey tool was designed to include key gender related information such as resources endowments, land use decisions, preferences and decisions along the value chain. Data entry and cleaning has just been completed and only preliminary analysis was done for this report using the women participation in household decision making index (WPHDMI). Results show that of the 13 studied decisions along the crop and livestock production value chains, women influence or independently make most of the decisions as compared to men. Men made independent decisions only in a few households mostly with regard to agricultural field management. Despite the fact that men are regarded as heads of households, the trend in this study shows greater bargaining power that women have in matrineal matrilocal and matrineal patrilocal systems. Under patrilocal systems, husbands maintain a certain level of control over all decisions while a woman has greater control over decisions regarding use of resources. In matrilocal system, however, the husband contributes to the decisions made in the household with woman having more weight especially when deciding on use and management of income. With regard to food and cash crop production, results show that husbands dominate in decision making of all cropping activities during the process of crop production. The wives role is prominent regarding the quantity to be sold (probably against what is kept for food) and usage of money from the maize sales. In cropping decisions for maize production husbands and wives do not interact to make unanimous decisions. For the cash crop tobacco, wives participate in decisions only when it comes to use of income. The above results are overall preliminary and detailed analysis will be done and communicated in the upcoming reporting period.

Though an attempt is made to conduct such quick analysis, further training or assistance from gender experts will be needed to conduct more detailed analysis and understand gender related issues in the study areas. It will also be vital to get training on formulation of research questions related to gender. There was also a difficulty to incorporate 'gender' related components into the socio-economic survey tool that results in delayed gender related data and analysis. We revised the tool and collected data for three sites in Malawi after consulting and getting advice from gender experts. It is however wise to mention that the 'Gender Training' organized by the DS was very helpful.

The methodological framework adopted to assess agricultural biodiversity and dietary diversity is gender disaggregated.

Ample attention was given to gender in the Treesilience book, which described the benefits from trees from a gender perspective.

Men and women have been engaged in decision-making and discuss on identification of promising innovations for alternative livelihoods and household income diversification in DGIS project sites in Ethiopia and Kenya. In addition in Kenya a gender and inclusiveness study was conducted as part of the characterization studies to contextualize issues of women, youth and other marginalized groups in order to target interventions better in the main implementation phase. These studies were conducted through sex-differentiated focus group discussions and results validated by various stakeholders majority of who were farmers with equal representation of men and women and who were also involved in planning interventions

E. PARTNERSHIPS BUILDING ACHIEVEMENTS

Strategic Partnerships were forged with key development partners such as Total Land Care who are focusing on looking at ways of sustainably increasing agricultural production through use of irrigation, improved seeds, fertilizer and better agronomic practices. Total land Care aims to build upon what people are already working on.

Strategic Partnerships have also been developed with in-country universities such as Chancellor College – University of Malawi. This has further deepened the research for impact approach where research is looking for solutions for the farmers in Ntcheu District and the Chinyanja Triangle at large.

In East Shewa partnerships were established with national agricultural research institutes Ethiopian Agricultural Research Institute (EIAR) and Oromia Agricultural research institute (OARI), NGOs International Development Enterprise (IDE), Valley Children and Women Development Organization (RCWDO), Serve Ethiopia Development Association (SEDA), government extension departments of Bureau of Agriculture (BoA) at Woreda and Kebele level), and private for profit organizations Admitullu Pesticide Company and micro financing company as well as farmer organizations. In general, partners have realized the potential synergies that emerge out of collaborative work. However, for successful collaborative there is a need to define the roles and responsibilities of each partner and all proceedings need to be transparent. The IP process followed contributed positively to develop such partnerships.

The work being carried out in East Shewa is in line with the priorities of Government of Ethiopia. The government places high emphasis in developing drylands and has major initiatives such as sustainable land management program. The work builds on these initiatives and makes best use of the investments made by the Government in land management. The work improves the effectiveness of the incentives that the government is providing to promote construction of farm ponds, promotion of small scale irrigation systems and afforestation schemes. It is also contributing to strengthening the farm training centers established by developing tailored training programs and by enhancing the capacity of extension agents to provide extension services as required by the end users.

The work also takes advantage of the developments in CRPs on dryland cereals, grain legumes and CCAFS. The climate services work of CCAFS is integrated with the interventions in East Shewa to manage the impacts of climate variability effectively. Historical and current climate information including seasonal climate forecast information is used in planning and managing farm operations in a way that makes best use of favorable conditions while protecting from the risk during unfavorable seasons. This is helping in preparing the farmers to future changes in climate as well. Improved varieties of pigeon pea, sorghum, and other crops developed under legume and cereal CRPs is also integrated with the interventions that are identified for on-farm and on-station testing and demonstration.

In Mozambique, partnerships continued with IIAM, as part in Innovation Platform processes and on-farm participatory technology development. The partnership was also extended with a local NGO, Aceagrarios, after successful legalization of the local level IP as AAPACHIMA association, on exploring improved livestock market options with farmers, extension and private sector.

We continued our partnership with the existing ones (research institutions of Malawi, Mozambique and Zambia) as well as Total Land Care (NGO). Because of limited activities in Mozambique and Zambia, we currently collaborate with TLC alone. We have close relationship with Lilongwe University of Agriculture and Natural Resources (LUANA) and discussed on possibilities of working together. There is a possibility to attach and use Masters and PhD students. We have also discussed with WLE for possible collaboration in the CT. From the DS program, CIAT and IWMI participated in a 'scooping tour' organized by WLE in November 2013 and discussed the possibility of having integrated activities in the region. Details will be reflected when the 'scoping tour' report is available.

DGIS Ethiopia. In Ethiopia partnership building focused on organizations having reputation on Food Security, Soil & water conservation, NRM, rural economic development and who has grass root presence at semi-arid areas of Tigray & Rift Valley. We commenced approaching these organizations by inviting to national launch event held in Jan 2014. The identified potential organizations presented their experiences at the Workshop. Following the workshop we asked both seven (OXFAM America, SNV Ethiopia, REST, Boset Child Fund, EOC…) of them if they are interested to work with us. This is followed by official invitation to fill due diligence and financial risk analysis tool. The filled due diligence is presented to selection committee composed of Finance Manager, Grant Programs Manager & Program team. Besides, WVE team visited some of potential offices to have more information. Generally, the process took about three months. In fact, WVE also signed MoU with Oromiya Agricultural Research Institute (OARI). This one took almost one month.

DGIS Kenya. In Kenya the project has a leadership blend between research and development partners who have gelled well and have a functional horizontal relationship. While development partners have implemented most of the action, technologies are sourced from research partners while the next phase of implementation will see formation of innovation platforms. County governments are an integral part of the partnership established through MoUs while plans are in place to formalize participation of farmer organization representation at the project country

F. CAPACITY BUILDING

The work is targeting to improve the capacity of the extension agents to provide location specific advisories to the farmers and capacity of the farmers to make more tactical decisions. Food feed crop trainings/on-farm demonstrations in Mozambique, Changara and Manica, Food feed crop trainings/ on-farm demonstrations in Zimbabwe, Gwanda and Nkayi, livestock feeding trainings/ on-farm demonstrations in Zimbabwe, Gwanda and Nkayi, Groundnut seed production trainings/ on-farm demonstrations in Zimbabwe, Nkayi and IP workshops in East Shewa, Mozambique and Zimbabwe have helped in enhancing the capacity of extension agents and farmers involved. About 2,500 participants from different categories benefitted from these trainings. Training in the use of crop simulation models has helped researchers in EIAR to conduct ex-ante assessment of benefits from various interventions with due consideration to the soil and climatic conditions in the target regions. They are also using these skills in other projects such as Agricultural Model Improvement and intercomparision (AgMIP). In addition, four MSc students are doing their thesis research in the action sites.

Under the Africa RISING trials, 46 farmers were trained in best bet practices for maize-legume production through soil fertility improvement, varieties and crop management. Four extension officers that were providing technical support also received training in the practices and data management. During the agronomic surveys, three agricultural research officers received training on agronomic data and yield component measurements, which they say is better than the government's current visual yield estimation done by Extension Officers. There is a possibility that the agronomic method exercised in our sites will be further adopted and used by extension officers.

As part of capacity building exercise and strengthen relationships and collaboration with the LUNAR University, two attached students have worked on data principles and processes of agronomic and socio-economic surveys, data entry and management and basic analysis. Another student from Sokoine University of Agriculture (Tanzania) has also been attached and the aforementioned areas. The trainees reflected that they have benefited a lot from the exposure they have.

DGIS Ethiopia. In Ethiopia capacity building training is given mainly on apiculture, mungbean agronomy & nutrient value, FMNR, importance of *F. albida* tree spp, balanced fertilizer usage, Cooperative finance management, business development, entrepreneurship, water harvesting, vegetable commercialization, value chain, NRM, energy efficient technology, etc. both for men, women & youth. For instance 106 model farmers and six development agents (DAs) were trained in Kilite Awlalo on zero/controlled grazing. As a result, controlled grazing is being attempted by trainees. A total of 121 farmers and 25 model famers have received trainings on Mung bean (Boset District) and horticultural crops. The trained farmers cascaded the training they have received to other farmer colleagues based on a government structure of a model farmer coaching 5 of his other fellow farmers and make the area Mung bean produce village. These farmers are accessed the seed. In the Boset district, 200 economically vulnerable women were organized in to four different groups and trained on the production, benefits and utilization of energy efficient cook stoves. This group commenced production and selling of the stoves. In the Kilite Awlalo district, 96 farmers (73M and 23F) and 4 Development Agents were trained on horticultural crop management with the training content covering the lay out, land preparation, irrigation frequency/interval, and soil fertility improvement and over all fruit crops management

DGIS Kenya. In Kenya the DGIS DRYDEV project trained a total of 3502 farmers in Kenya on various technologies related to agronomy, drought tolerant crops and water harvesting. 4 bachelor students conducted research in the project area on water harvesting approaches

G. RISK MANAGEMENT

One of the key risks for 2014 was the elections which took place in Mozambique which is part of the Chinyanja Triangle. This was addressed by scheduling fieldwork so that it did not coincide with the political campaigns and the election dates.

While no major risks are envisaged the policy and government programs in different countries will have a bearing on scaling up of the results to other countries in the region. For example the incentives provided by Government of Ethiopia to promote water harvesting, small scale irrigation and afforestation are unique opportunities contributing to the successful implementation of the planned activities and achieve projected outcomes. Similarly, Ethiopia has a fairly big extension system compared to many other countries in the region which is contributing to rapid extension of the results to other areas. The site specificity of some of the interventions is also a constraint. These can be overcome partially using the new information and communication technologies including videos and by well defining the requirements for targeting specific technologies.

We had challenge of theft as some of the best performing baby trials were stolen just before harvest. While this can be 'positive' as the theft is associated with very high performance of the trials (it is believed that those who have stolen wanted to use the seed for planting the coming season), it has implication on our results. It could also affect farmers' participation in trials as theft is mentioned to be one of the major constraints of farmers in the CT countries (especially Malawi and Mozambique) based on a focus group discussion during an WLE scooping tour. We tried to create awareness and explain to the community that stealing pods of trials could amount to destroying what we tried to do and our final results may not be able to provide the right suggestion for improving crop productivity. We also suggested that those who are in need of seeds can apply and we try to find solution rather than steal farmers' experiments.

Another challenge is resource availability to monitor and manage the trials. This is especially so because follow-up by local extension workers is not sufficient either because they pay less attention or they are tied up with many activities especially during the growing season. The consequences of the insufficient follow-up resulted in ineffective and inefficient use of pesticides (not applied when the problem arises), weeding and weed management, overall follow-up of the condition of the trials and reporting on time. We tried to rectify this by sending research assistants and researchers to the sites which makes the process expensive.

Floods, torrential rains and impassible road networks in Malawi are risks that can hinder expected delivery of results**.**

DGIS. Major risks to be mentioned from Ethiopia side include. Inflation - An increasing inflation rate could affect the exchange rate and project expenditures. Capacity of the community -The risk-averse and capital-poor nature of farmers means that their reluctance to invest in new technologies will call for vigorous awareness creation and skill training. Partner capacity - There is a strong foundation of partner capacity existing in most of the thematic areas of the project based on prior collaboration and proven grass root capacity. However, there are some areas where existing capacity may be lacking, such as how to measure water productivity. Political instability – community level resource sharing conflicts at grass root is a possible threat to achieving project objectives in some locations. Climate change/external shocks, particularly droughts -These may further weaken the resilience of vulnerable

poor rural households as this project is targeting semi-arid areas. Partners' cooperation- working with partners is an opportunity to cross learning and capacity building. Equally any un-foreseen failure happening in one or more partners can affect the project.

H. LESSONS LEARNED

High level of confidence

The most important future area of research is on how to identify entry points and interventions that build on the agricultural biodiversity maintained by rural households in target areas. This is an area that still merits much research.

There is a bit of uncertainty associated with the indicators such as number of technologies and tools developed. In many cases the tools and technologies are the ones adapted to meet the location specific conditions than developing entirely new tools and technologies. Technologies such as water harvesting structure and improved varieties are not the developed directly under this CRP but they are adapted to suite the local conditions and there by increased adoption. However, they do serve to assess qualitatively the progress made in achieving the targeted outputs and outcomes.

Though it is understandable that some targets should be set to monitor progress, some of the indicators shown for some specific categories seem to be challenging to estimate. For instance, it may be difficult to know the potential number of users of an open access database. In addition, the estimate of the total population of an agro-ecosystem will be as good as population estimates for the countries/districts/regions within the respective systems. Same is true for the number of people who will potentially use plans and/or technologies.

Most of the research activities planned have been executed except that the rainy season in Southern Africa where most of the field data planning and implementation takes place comes around November/December, which is influenced by late release of budget and PPA. Such has mainly influenced involving partners as there is a need to sign MoU beforehand. There is a possibility to pre-finance activities but this can be complicated especially under the current uncertainty of amount of budget from CRPs.

There is an overall progress towards achieving goals in the Chinyanja Triangle. Now there is more clarify of the systems approach and better structure is in place to better execute activities and achieve targets. However there is a need to be realistic in setting targets and outcomes. Most can be achieved in the long-term (5-10 years phase) and there should be care to define realistic expectations.

DGIS. In the first year, several lessons have been learned. The first is on the extension of the impact pathway. The DGIS project is implemented to achieve development goals through partners (NGOs, Research, Sector offices of Government and community). This allows a research organization like ICRAF to extend its impact pathway to reach significant farmers with the techniques and information that the CGIAR has to offer. The cooperation with these development partners thus allows ICRAF to leverage change and the adoption of techniques and interventions.

The complementary expertise of partners is found to be really useful in achieving this. Regular joint monitoring and review meetings to discuss lessons and providing feedback are found to be very helpful.

This facilitated co-learning, helped devising effective strategies that led to smooth implementation of the inception phase.

A second lesson is on the benefits of cost sharing, the contribution of stakeholders in the form of labor and local material and financial support from the local government helped reaching more people than targeted. Also, the community's and local government involvement and cost sharing created a greater commitment and sense of ownership.

A third lesson was that implementing intervention through existing Farmer Organizations such as multipurpose cooperatives enabled us to scale-up and reach larger numbers of community target groups. At the same time, capacities of these FOs are further enhanced and the project intends to continue working on these lines. This will help achieve the program objectives as well as enable the FOs to continue working for local development in future even without support from the program.

The fourth lesson was on cooperation to create leverage. The project has been building on the existing initiatives of the government, local partners and the communities, which was advantageous in terms of avoiding duplication of development efforts, utilizing resources more efficiently addressing diverse target groups and smooth and quick implementation. However, this strategy entails some disadvantages and challenges such as attribution of the impact and changing attitude of the community to adapt to new implementation strategy (cost sharing/community contribution).

Annex 1: CRP indicators of progress, with glossary and targets

CRPs concerned by this	Indicator	Description of Indicators and their measured	Deviation narrative	2013		2014		2015
				Target	Actual	Target	Actual	Target
KNOWLEDGE,TOOLS,DATA								
All	1.Number of flagship "products" produced by CRP	The book "*Treesilience, an assessment of the resilience provided by trees in the drylands of Eastern Africa*" was accompanied by one technical and one policy brief, a factsheet, two blogs and one publication in the Link, see: http://www.worldagroforestrycentre.org/knowfor The book has been promoted up by other organizations such as FAO on Twitter, ClimateNet, and IFAD http://www.slideshare.net/ifad/gef6-nrm-resilience. Multi-stakeholder innovation platforms (IP) are operating in Ethiopia (east Shewa) Mozambique (Changara, in Tete Province, Manica in Manica province) and Zimbabwe (Nkayi and Gwanda in Matabeleland) IBLI – Takaful Insurance of Africa 2014 media coverage. https://www.dropbox.com/s/snqad729mlhiv4f/2014-04-23%20FINAL%20Media%20Coverage%20Compilation%20-%20ILRI-IBLI%20Wajir%20Payout.pdf?dl=0		4	4	3 5	7 5	5

		IBLI Case Study - To be used for teaching management and social entrepreneurship lessons to business school students globally, will discuss the management problems and business challenges that the IBLI program has solved so far, as well as those it continues to tackle today. Written by Iddo Dror, Shreya Maheshwari and Andrew Mude (2014) Using satellite data to insure camels, cows, sheep and goats: IBLI and the development of the world's first insurance for African pastoralists https://cgspace.cgiar.org/bitstream/handle/10568/51647/PR_ibli_nov2014.pdf?sequence=1 IBLI Newsletter entries						
All	2.Number (from 1)of flagship products produced that have explicit Target of women farmers/NRM managers	The treesilience book was targeted to include gender in its review of resilience from trees. Women represented at IPs, high potential value chains favoring women prioritized (legumes and goats), capacity development and technical solutions tailored to women		4	4	1 5	1 5	5
All	3.Number (from 1) of flagship products Produced that have been Assessed for likely gender- disaggregated impact	The book "*Treesilience, an assessment of the resilience provided by trees in the drylands of Eastern Africa*" included multiple chapters with sections reviewing gender for many of the reviewed benefits of trees, see: http://www.worldagroforestrycentre.org/knowfor. Constraints faced by women farmers assessed through baseline surveys Goat and legume value chains being analyzed including a gender perspective		4	4	1 5	1 5	5

All	4.Numberof"tools" Produced by CRP	Outputs: Reports (N. 2) and presentations (N. 1) on developing the use of farmer typologies to enhance adoption of intensification technologies in crop-livestock systems were developed for Mashonaland East Region (Goromonzi and Murehwa Districts) and Matebeland North (Nkayi District) and South (Gwanda District) , using data from 800 farming households who were interviewed in the project's Baseline survey. A total of from the abovementioned districts were assessed in the baseline survey. One MSC student from the University of Zimbabwe produced a thesis in May 2014 on the use of simulation modelling to identify priority interventions in mixed crops - livestock systems for different farm types (involved in dairying), in Goromonzi district. Outcome: At least 50 % staff from 3 CGIAR institutions, 2 NARES and 2 NGOs participating in the ZimCLIFS Project have used farmer typologies to assist farmers in making informed choices of appropriate. Over 3600 farmers adopted crop-livestock options in Zimbabwe using the Lead farmer approach. The technologies are expected to benefit 20,000 farmers by the Year 2016 Conference papers:				1 1 1 530	2 1 7 3,600	 1 5,000

		Output: Three types of forage seed production models were initiated for communal farmers in Mashonaland East Province (N. 2 districts):- N1 were at a Dairy hub/Milk Collection Centre. N. 3 were community based seed multiplication gardens N.12 were individually owned forage seed multiplication plots that were established on the individual's arable lands. NARES (N 4 female and 2 male, extension staff trained) and farmers (9 male and 3 female) farmers were trained in forage seed multiplication in Mashonaland. Outcome: Availability of forage germ plasm in Zimbabwe was improved, especially to smallholder dairy farmers. Output: A pilot test of an analytical framework for measuring impact of interventions on resilience was carried with data for Marsabit Kenya. A conceptual flash flood early warning system was developed. The system uses rainfall intensity data from terrestrial microwave communication links and the geostationary Meteosat Second Generation satellite. Flash flood early				1 3 12 18 - -	1 2 12 18 5tons -	 30 10tons -

		Develop procedures pf exploring the possibility of detecting large animals using very high- satellite images. A hybrid image classification method was employed incorporating pixel-based and object-based image classification approaches. This was performed in two steps: firstly, a pixel-based image classification method, i.e., artificial neural network was applied to classify potential targets with similar spectral reflectance at pixel level; and then an object-based image classification method was used to further differentiate animal targets from the surrounding landscapes through the applications of expert knowledge. IBLI Training and Extension Materials IBLI training and marketing materials. https://livestockinsurance.files.wordpress.com/2015/01/types-of-extension-and-research-methods.pdf Trade-off analysis (TOA-MD): Paper published on tradeoffs in crop residue uses Typologies: farm typologies developed based on household baseline and verification for tailoring interventions				4	2	4
All	5.Number (from 4) of tools that have an Explicit target of women farmers	Revise and improve the socio-economic survey tool used in 2013 to include/enable collect gender-disaggregated data. To be uploaded.						

All	6.Number (from 4) of tools assessed for Likely gender-disaggregated impact	Gender is included in those publications, but they are not yet published				4	2	4
All	7.Number of open access Databases maintained by CRP	Socio-economic survey data (5); agronomic survey data (3), field trial data (2), soil and landscape data (7). The numbers in brackets show number of sites for which data is available across CT. IBLI Marsabit Household Survey Data • link to round 1 data • link to round 2 data • link to round 3 data IBLI Borena Household Survey Data • link to round 1 data • link to round 2 data	2	2	3	4	3	2
All	8.Total number of users of These open access databases	Total Land Care, LUNAR University, Extension Officers within the different Extension Planning Areas, and other projects in the region. Please note that we mentioned institutions and not individual users.		2	2	2	3	3

All	9.Number of publications in ISI journals produced by CRP	De Leeuw, J., Vrieling, A., Shee, A., Atzberger, C., Hadgu, K.M., Biradar, C.M., Keah, H. and Turvey, C., 2014. The potential and uptake of remote sensing in insurance: a review. *Remote Sensing, 6, 10888-10912* Yang, Z., Wang, T., Skidmore, A.K., de Leeuw, J., Said, M.Y. and Freer, J. 2014. Spotting East African Animals in Open Savannah from Space. *PLOS ONE*, DOI: 10.1371/journal.pone.0115989 Produced a draft synthesis report on priority research gaps for integrated crop-livestock systems in semi-arid Zimbabwe. The report will submitted for publication in a scientific journal				2	2	

1,2,3,4,6	10.Number of strategic Value chains analyzed by CRP	Three value chains: one new farmer group, a new farmer and one new private agro-dealer were engaged in Angonia and Moatize Districts in Mozambique. The agro-dealer, IAP-Tete is also a supplier of agro inputs such as fertilizers and pesticides and this gives an opportunity to ease input supply in Angonia. Two innovation platforms in Balaka and Machinga districts in Malawi under the Sub Sahara Africa Challenge Program. These platforms promoting conservation agriculture with pigeon pea and maize as the main value chains. This year saw farmers in these two districts linked to both input and output markets. NASFAM and AGORA are the main input markets supplying farmers with inputs. Agriculture Commodity Exchange is the main output market. It buys farmers' produce in bulk and stare in their ware house as it source for other output markets on behalf of farmers. **Output:** **Operational district-level (N. 2) and ward–level (N. 1) Innovation Platforms for maize, sorghum, groundnut, and livestock were established in Matabeleland and 8 Ward-level innovation platforms were established in Mashonaland East Province of Zimbabwe** **Innovation platform reports (N. 2) produced, detailing technical and institutional interventions to improve farmer's access to beef and dairy value chains in Mashonaland and Matabeleland. In addition, information to profile critical value chain actors was also collected in both provinces.** **Outcome:**			3	3 5	3 8	3

1,5,6,7	11.Number of targeted agro-ecosystems analyzed/characterized by CRP	The DGIS project implemented in semi-arid tree-crop-livestock systems undertook characterization studies for project sites in Ethiopia and Kenya. The project intervention sites are chosen using predetermined criteria of rainfall range (400-800mm), levels of food insecurity, relative density of population and areas bounded within the delineated map in the original program document. The work is still in progress and reports will be published in 2015. 1. Maize-legume intercrop (beans and pigeon peas)		2	2	2	5	1
1,5,6,7	12.Estimated population of above-mentioned agro- ecosystems	Around 2000 households (10,000 people) so far benefited from the DGIS project in Ethiopia. The total number of people in these districts is much larger and will be available in the characterization study. ISFM bean integration technologies are implemented in Linthipe and Kandeu EPAs SLM technologies are implemented in Nsipe EPA Socio-economic and soil survey in Chipata and Macanga		126,533	142,839	199,985	209,985	130,436
CAPACITYENHANCEMENTAN D INNOVATIONPLATFORMS								
All	13.Number of trainees in short-term programs facilitated by CRP (male)	The DGIS DRYDEV project trained 3340 farmers (2308 men, 1032 female) in Ethiopia and 3502 farmers (1042 men, 2459 women) in Kenya. Given that the inception report and work plans have not yet been completed it is impossible to forecast deliverables for 2015. The training includes mainly those on job to conduct survey (soil/landscape), agronomy, socio-economic and crop management practices including use of inputs. Over 45 farmers trained on best-bet ISFM practices. In addition, 4 extension officers trained to backstop trial management. Three agricultural research officers have been trained to		27	24	66	6907	130

		Food feed crop trainings/on-farm demonstrations in Mozambique, Changara and Manica (30 farmers and 4 extension officers each Food feed crop trainings/ on-farm demonstrations in Zimbabwe, Gwanda and Nkayi (n=). Livestock feeding trainings/ on-farm demonstrations in Zimbabwe, Gwanda and Nkayi () Groundnut seed production trainings/ on-farm demonstrations in Zimbabwe, Nkayi IP workshops in Mozambique and Zimbabwe (at 2 sites each, including 30-40 participants (n=120-160) ENSURE project **Collaboration with CSU and CSDES** Personnel from ILRI worked with collaborators from Colorado State University (CSU) and the Centre for Sustainable Dryland Ecosystems and Societies (CSDES) of the University of Nairobi on a capacity building initiative on collaborative research methods. CSDES has been a strategic partner for dryland research and policy engagement in Kenya, collaborating with ILRI and other CG centers on various initiatives in drylands. ILRI personnel worked with CSU personnel to develop a short course on this topic aimed primarily at graduate students from CSDES and other departments and faculties at the University of Nairobi. The three-day course was delivered by personnel from ILRI. The effort has helped to build capacity for systems research among this key partner. Twenty-five (25) students attended the course. **PhD Dryland Program** Swedish University of Agricultural Sciences (SLU), Jomo Kenyatta University of Agriculture and Technology in collaboration with ILRI, University of Nairobi and ICRAF organized a multidisciplinary PhD course on restoration of degraded semi-arid landscapes – livelihood, livestock and land use. Nineteen (19) PhD students from SLU and Eastern Africa		70 168 68 60 120-160	70 168 68 60 120-160	70 1250 68 600 120-160	70 1250 68 600 120-160	

		Devolution, Rangeland Governance and Pastoralism. Panel discussion: Held at the 6th All Africa Conference on Animal Agriculture, 27 – 30 October 2014, Nairobi. Panelists: Hewson Kabugi, Director, State Department of Environment and Natural Resources, Forest Conservation, Kenya Ministry of Environment, Water and Natural Resources; Dr. Solomon Desta, Director, Managing Risk for Improved Livelihoods; Prof. Jerome Gefu, National Animal Production Research Institute; Hon. Chachu Ganya, Member of Parliament, for North Horr, Kenya. **Participatory mapping of livestock stock routes in Tanzania** The International Land Coalition (ILC), Tanzania Livestock Research Institute (TALIRI) and the International Livestock Research Institute (ILRI) developed participatory methods of mapping livestock routes. More than 30 participants						
All	14.Number of trainees in short-term programs facilitated by CRP (female)	In Ethiopia and Kenya 1032 and 2459 female were trained respectively. Given that the inception report and work plans have not yet been completed it is impossible to forecast deliverables for 2015, but is likely to be higher. 39 female farmers have been trained on best-bet ISFM practices, 1 extension officer trained to backstop managing agronomic				41	3532	120
All	15.Number of trainees in long-term programs facilitated by CRP (male)	The DGIS project trained Kenyan 2 students in investment analysis of rainwater harvesting. Given that the inception report and work plans have not yet been completed it is impossible to forecast deliverables for 2015. 2 MSc Students in Mozambique The project on livelihood diversifying potential of livestock based carbon sequestration option in pastoral and agro		2	2	2 2	4 2	2

All	16.Number of trainees in long-term programs facilitated by CRP (female)	In Kenya the DGIS project trained 2 students in investment analysis of rainwater harvesting, Given that the inception report and work plans have not yet been completed it is impossible to forecast deliverables for 2015. The project on livelihood diversifying potential of livestock based carbon sequestration option in pastoral and agro pastoral systems in Africa have 1 female PhD (1 Kenya)				0	2 1	
1,5,6,7	17.Number of multi- Stakeholder R4D innovation platforms established for the targeted agro-ecosystems by the CRPs	In Kenya none in 2014. In Ethiopia three. Given that the inception report and work plans have not yet been completed it is impossible to forecast deliverables for 2015. Dzimeza Innovation Platform, Angonia District, Mozambique. Focuses on beans. Balaka Innovation Platform, Balaka District, Malawi. Focuses on Conservation Agriculture with Pigeon Pea and maize as carrier technologies Machinga Innovation Platform, Machinga District, Malawi. Focuses on pigeon pea and maize as commodity of choice. The legume maize integration also aims at addressing soil fertility management.		2	2	3	6	1
TECHNOLOGIES/PRACTICES IN VARIOUS STAGES OF DEVELOPMENT								

All	18.Numberof technologies/NRM practices under research in the CRP (Phase I)	In Kenya in 2014 the DGIS project reviewed 4 crop varieties and 4 rainwater harvesting techniques. In Ethiopia nine technologies were tested, including improved crop seeds, Bee hives, Maize thresher, improved animal breeds, locally better performing breeds, artificial insemination, FMNR, soil and water conservation structures, and tree seeds. Given that the inception report and work plans have not yet been completed it is impossible to forecast deliverables for 2015. High yielding bean varieties (5) Chicken manure, pigeon pea +maize intercrop (2) NP+S and NP+S +chicken manure in maize-beans intercrop (2) Insecticides and fungi- & bactericides for P&D control in beans (2) East Shewa: Arresting degradation and rehabilitation of degraded lands Enhancing productivity Enhancing income Mozambique:				6 3	27 3	11 3
		Zimbabwe: Food feed crop and forage management Mucuna as organic fertilizer and feed biomass, and seed as source of income Soil fertility management using crop rotation maize/sorghum mucuna, manure application, inorganic fertilizer Livestock feeding of crop residue/forage mixtures Mucuna as organic fertilizer and feed biomass, and seed as source of income Groundnut seed production			9	10	10	
	19.Number (from 18) of technologies under Research that have an explicit target of women	In Kenya all four techniques mentioned under 18 target as well to women farmers. In Ethiopia Water harvesting for garden development was specifically targeted at women				0	5	2

All	20.Number (from 18) of technologies under Research that have been assessed for likely gender- disaggregated impact	East Shewa: Arresting degradation and rehabilitation of degraded lands Enhancing productivity Enhancing income Mozambique: Food feed crop and forage management Mucuna as organic fertilizer and feed biomass, and seed as source of income Zimbabwe: Food feed crop and forage management Mucuna as organic fertilizer and feed biomass, and seed as source of income Soil fertility management using crop rotation maize/sorghum mucuna, manure application, inorganic fertilizer Livestock feeding of crop residue/forage mixtures Mucuna as organic fertilizer and feed biomass, and seed as source of income		5	5 9	3 4 4 5 10	3 4 4 5 10	3 5 4

1,5,6,7	21. Number of agro-ecosystems for which CRP has identified feasible approaches for improving ecosystem services and for establishing positive incentives for farmers to Improve ecosystem functions as per the CRP's recommendations	The DGIS project works on improvement of delivery of a number of ecosystem services, first the soil moisture and fertility that underpin agricultural production, second the regulation service of transfer of water at the level of a catchment and third the provisioning services in the form of food, firewood and other tree products. The project is implemented 3 three semi-arid agro-ecosystems in Ethiopia (2) and Kenya (1) respectively. We will conduct ecosystems assessment in Ntcheu district (CRP1.1 Action Site) under a BMZ bilateral project. Part of the project is mapped to the DS while the rest will be				3	3	1
1,5,6,7	22.Number of people who Will potentially benefit from plans, once finalized, for the scaling up of strategies	By the end of the DGIS project 14000 households in Kenya, 14,000 households in Ethiopia will have benefited from the scaling of project interventions. The targeted out-scaling area is at district level where technologies tested at EPAs will be out-scaled. In the long-run, dissemination will be based on 'recommendation domains' (similarity mapping) East Shewa: 1 million					28,000	1,096,034

All, except 2	23.Number of technologies /NRM practices field tested (phase II)	Two (2) in Kenya; Rainwater harvesting (Zai pits, sunken beds, retention ditches, terraces) and drought tolerant crops (sorghum, pigeon peas, cow peas and green grams) have been field tested in Kenya. Two (2) in Ethiopia; tea and vegetables (onion and tomato) were tested using irrigation from rain-harvested technologies introduced by the project. ISFM and SLM options including box-ridges, CA, double-up legume, green manure (agroforestry) are being tested for possible duplication. East Shewa Intercropping with pigeon pea Water harvesting and small scale irrigation Vegetable production Soil fertility enhancement with legumes Water conservation by trenches Zimbabwe, Gwanda and Nkayi: Mucuna as organic fertilizer and feed biomass, and seed as source of income Soil fertility management using crop rotation maize/sorghum mucuna, manure application, inorganic fertilizer				2	6	3
		IBLI – Expansion from Marsabit, Kenya (2010) to • Borana, Ethiopia in 2012 • Isiolo & Wajir, Kenya in 2013 • Garissa & Mandera Kenya in 2014 Multiple types of contracts have been developed for the counties of Northern Kenya not mentioned above, including Turkana, Tana River, Moyale, Baringo, Samburu, & Ijara, but we have yet to launch in these areas.		2	3	3	5	4

1,5,6,7	24.Number of agro- Ecosystems for which innovations(technologies, policies, practices, integrative approaches) and options for improvement at system	The above technologies were implemented in two agro-ecosystems: cereal-legume dominated and mixed crop-livestock system. The former was associated with Dedza district there are still livestock components. The activities will be continued in these systems. East Shewa, Nkavi and Gwanda semi arid southern				2	2	1
1,5,6,7	25.Number (from 24)of above innovations/approaches/options that are targeted at decreasing inequality between men and women							
1,5,6,7	26.Number of published research out puts from CRP Utilized in targeted agro- ecosystems	ICRAF managing the DGIS project stimulated the NGOs implementing the project to review lessons learned previously and elsewhere, this should be reflected in the characterization studies that are currently being finalized and will be available in 2015. Zimbabwe: Beef handbook, groundnut flyer, food feed crop flyer (Drafts)					1	1
All, except 2	27.Number of technologies/NRM practices released by public and private sector partners globally (phase III)	ISFM and SLM trials will be up scaled to other parts of the Dedza and Ntcheu districts. CA is being scaled out in Balaka and Machinga districts under the Sub-Sahara Africa Challenge Program project. This is the same with pigeon pea which is being integrated with maize. Pigeon pea is a multi-purpose crop that was identified as a viable technology				2	2	3
POLICIESINVARIOUSSTAGESOF DEVELOPMENT								

All	28.Number of policies/ Regulations/Administrative Procedures Analyzed (Stage1)	In Kenya and Ethiopia in 2014 twelve (12) and five (5) policies that impact on agricultural productivity and markets and value chains have been reviewed, results will be published in the characterization studies that will appear in 2015.		16	16		18	17
All	31.Number of policies/ regulations/ administrative procedures prepared passed/approved(Stage4)	The IAR4D approach is in the process of being entrenched in the National Agricultural Policy. At the moment it is entrenched in The Agriculture Sector Wide Approach (ASWAp) and only guides agriculture extension in Malawi as a whole.				2	2	1
All	32.Number of policies/ regulations/ administrative procedures passed for	IBLI involvement as committee member and contributor to the "Kenya National Agricultural Insurance Policy Taskforce. https://www.dropbox.com/s/nblr1klzr0yja71/NAIP_Report2013.pdf?dl=0						
All	30.Number of policies/ regulations/ administrative procedures drafted and presented for public/stakeholder consultation (Stage2)	One policy related to "Agriculture Research and Extension" was being analyzed in Malawi under the SSA,CP. The focus was on the application of IAR4D as a country wide approach to drive agricultural research and extension in Malawi.				1	1	
OUTCOMES ON THE GROUND								
All	33.Number of hectares under improved technologies or management practices as a result of CRP research	The DGIS project started in 2014, it aims at 100 000 ha (Ethiopia) and 100 000 ha (Kenya) by the end of the project (2018).				20	200,002.3	15
		The mother baby trials were located in Dedza and Ntcheu and this was the first year to introduce new technologies						
		Area estimated for trials/demonstrations (ha)						
All	34.Number of farmers and Others who have applied new technologies or management practices as a result of CRP research	In Kenya and Ethiopia 300 farmers upon demonstration and training organized by the DGIS project started applying zai pits. 39 new females in Dedza and Ntcheu districts of Malawi 7 new males- in Dedza and Ntcheu districts of Malawi				47	414	221

Annex 2: Performance indicators for gender mainstreaming with targets defined

Performance Indicator	CRP performance approaches	CRP performance meets requirements	
1. Gender inequality targets defined Collected gender disaggregated data through different approaches to ensure that women's constraints and objectives regarding land health and its relationship to their livelihoods are understood and		Collected gender disaggregated data through household surveys, focus groups and participatory landscape mapping to assess gendered livelihoods, constraints and opportunities. Gender is a central component of all the social science work in the project.	Reached
2. Institutional architecture for integration of gender is in place			

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