

Sustainable intensification of crop-livestock systems to improve food security and farm income diversification in the Ethiopian highlands

DRAFT CONCEPT NOTE

ILRI

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1. Background

USAID's Feed the Future initiative includes a research component on sustainable intensification, which addresses aspects of leveraging component technologies, broad support to mission strategies, and goes beyond productivity to social and environmental dimensions. Sustainable intensification is also a highlight of research in CRP1.1 and 1.2, both of which have locations in the Ethiopian highlands. For CRP3.7 *More milk, meat and fish by and for the poor* with a focus on small ruminant production, there are also opportunities to explore synergies of crop (and therefore potentially a number of the CRP3's) and livestock production in the framework of sustainable intensification, and with CRP5, which has similar aims in an ecosystem context.

Sustainable intensification is complex and multidimensional (Box 1), and addressing the intersection between crops and livestock provides a strategic focus with some key entry points such as the improved varieties of food-feed crops, feed value of crop residues, natural resource management (especially tradeoffs between animal fodder and soil and water conservation), integrating legume rotations, trees, and institutional innovations to improve access to markets and services. All of these have the potential to sustainably increase the productivity of USAID mission-selected and national priority crop and animal value chains, provided mechanisms are included to foster engagement such development sector, value chain focused end users. This focus provides considerable opportunities for synergies with ongoing (well resourced) crop breeding efforts, with the potential to address challenges at several scales.

A project of this size cannot address all the dimensions of sustainable intensification but there are significant opportunities for synergies with ongoing funded research and development efforts in the agricultural sector. Both livestock and crops play immensely important roles in Ethiopia's economy and in addressing food security and poverty. Maize, teff, and wheat are grown by 8, 5.8 and 4.2 million smallholders respectively; 70% of smallholder farmers depend on livestock for some part of their livelihoods, with the livestock sector contributing 35-49% of agricultural GDP. 60% of Ethiopia's poor are found in mixed crop livestock systems in the highlands where this project will focus specifically on improving productivity and environmental management, together with appropriate mechanisms to link to market opportunities and development projects, input and service providers, and therefore seek to leverage these.

The USAID mission goal is to enhance food security and cash income diversification among farm households in the Ethiopian Highlands. This will be achieved by strategic interventions to improve the productivity of crops and livestock and by working with stakeholders to develop value-chains for commodities with growing market demand, including dairy, meat, legumes, and cereals. The mission has highlighted the intersection of these dimensions – focal VCs and priority areas in Oromia and Amhara regions – especially the former, where issues of market participation and NRM relating to the “three Ethiopias” – hungry, productive and pastoral, have the potential to align.

Smallholder crop livestock systems such as those in the Ethiopian highlands present a need to explore viable options for sustainable intensification to improve food security and income opportunities for the poor as well as identifying potential tradeoffs, for example between the use of crop residues for animal feed, conservation agriculture or other purposes – with impacts on the environment (such as via the production base) as well as livelihoods; between crop varietal choices and combinations that may enhance feed availability and if these are possible without compromising food production or the underpinning production and marketing strategies.

Box 1. Sustainable intensification in the Ethiopian Highlands.

Pretty et al. (2011) describe sustainable intensification as “.....*producing more output from the same area of land while reducing the negative environmental impacts and at the same time increasing contributions to natural capital and the flow of environmental services*” and articulate seven key components of successful sustainable intensification, which in summary are:

- (i) science and farmer inputs into technologies and practices that combine crops–animals with agroecological and agronomic management;
- (ii) creation of novel social infrastructure that builds trust among individuals and agencies;
- (iii) improvement of farmer knowledge and capacity through the use of farmer field schools and modern information and communication technologies;
- (iv) engagement with the private sector for supply of goods and services;
- (v) a focus on women’s educational, microfinance and agricultural technology needs;
- (vi) ensuring the availability of microfinance and rural banking;
- (vii) ensuring public sector support for agriculture.

In the wheat based crop livestock systems of the Ethiopian Highlands, which consist of a mosaic of different cereal, legume, crop and animal combinations with differing market access and emerging demands for crop and livestock products it is possible to articulate how all these dimensions could impact on the future system transition. At farm household level, the majority of farms engage in a range of production enterprises, cereals, legumes, animals, some of which may be marketed, others of which may support production of the marketable commodities (eg legume rotations or intercropping, animals for manure). Increasing demand for crop and livestock products presents both a challenge and an opportunity – at present levels of production, it would not be possible to satisfy the demand and other (perhaps industrial scale) production enterprises may emerge – presenting a new set of environmental and livelihood challenges. However, it is possible that such crop livestock systems can transition to be more productive, environmentally sustainable and contribute to food security and income. This will require bringing together science and farmer inputs that enhance productivity of both crops and animals and improve natural resource management (i); it will mean that in order to have incentives for improved productivity, farmers need to be linked to markets (ii), both to ensure they have access to market and technology information (iii) as well as inputs and services (iv). In order to benefit from such improved market and knowledge access, credit options will need to be functional (vi) and both women and men – farmers, traders, processors, service agents, development and research sector – will need to be engaged (v) in the context of broad agricultural sector policy support (vii). The present project will not attempt to address all these dimensions, but will focus on the intersection of crop and livestock production, their related trade offs and potential trajectories. Use of crop residues is at the heart of this intersection, because crop residues are the major component of livestock feeding. However, when farmers feed residues this often leads to a progressive decline in soil fertility and health as well as promoting erosion. Crop residues alone tend to be poor quality feed meaning that farmers often have many poorly fed animals – using lots of nutrients to maintain animals rather than yielding substantial livestock commodity products. Under such scenarios, livestock are most often kept for multiple functions including to service arable production rather than as income sources per se. Improving livestock feeding strategies, through improving the quality and quantity of crop residues without compromising grain yield through the development of “food feed crops”, judicious combinations of crop residues and other feeds could take the pressure off crop residues and allow soil improving practices such as conservation agriculture, which also improve resilience to drought through soil moisture management to become more likely. Such a trajectory would potentially include some degree of specialization of crop and livestock production and require a robust assessment of the implications of this for resilience and risk management

The research proposed here has the potential for synergies with a number of other on going efforts. These include the national Agricultural Growth Program, the Livestock Growth Program, emerging efforts in the context of CAADP (<http://www.donorplatform.org/resources/library/article/5-caadp/230-ethiopia-caadp-compact/166-Itemid.html>). The ongoing phase IV of the SANREM CRSP focuses on increasing smallholder food security and adaptation to climate change through introduction of conservation agriculture production systems (CAPS), and may present some synergies in research approaches, but does not include research locations in the Ethiopian Highlands. The Livestock and Climate Change CRSP includes some work in pastoral areas and their linkages to markets in Ethiopia

Core research institutes leading this project (CIMMYT, Ethiopian Agricultural Research Institute (EIAR) ICARDA, ICRISAT, IFPRI, ILRI, IWMI) have a range of experience, competencies and on going work that are germane to the present project on sustainable intensification. A summary of the major opportunities for synergies with such work is given in Annex 1.

2. Overall Purpose and Objectives

The research-for-development work proposed here is premised on sustainable intensification as an approach to address the multiple challenges of productivity enhancement and food security, income generation and environmental sustainability in an equitable way through combining productivity improving technologies, interventions for natural resource management and institutional innovations that improve access to markets and services and enhance the functionality of social and human capital enabling smallholder farmers to adopt and adapt sustainability enhancing technologies. Our hypotheses are:

- That the potential trajectory for intensification – and therefore solutions to enhance sustainable intensification of smallholder crop livestock systems will vary depending on the initial level of intensification in the farming system, and the level of capital assets among farm households, which will also reflect the market opportunities for specific crop and livestock commodities and as well as institutional and policy environments
- There are real opportunities to improve productivity and environmental management through applying, combining and improving existing technological interventions
- Evaluation of trade offs between different combinations of interventions will further enhance targeting and ensure diverse livelihood dimensions, including opportunities for women are balanced
- Institutional innovations and options that build and enhance social capital – bonding, bridging and linking relationships are crucial to leverage growth opportunities and improve farmers' access to knowledge, inputs, credit and services and thus, market participation as well as potentially influencing the enabling policy environment

Purpose: To identify options for sustainable intensification of mixed crop livestock systems in the Ethiopian highlands that will enable communities to participate in emerging market opportunities in environmentally friendly ways whilst improving resilience to risks.

Objectives:

- To characterise the resource use strategies, their evolution in relation to major drivers and household typologies to map potential trajectories and sequence of solutions for sustainable intensification of crop livestock systems with starting points of different intensity in order to develop a model of sustainable intensification for crop-livestock in the Highlands that can be scaled out to enable broad-based productivity growth in farming systems characterised by population pressure and shrinking farm size
- To enable co development (farmers, private entrepreneurs, development and research sectors) in selected benchmark learning sites of combinations of crop, livestock and natural resource management technologies to develop locally adapted and farm specific intensification options
- To evaluate biophysical, economic and social trade offs and opportunities in particular at the crop-livestock-soil intersection of biomass production and use

- To identify appropriate strategies to build the needed social capital for responsive, resilient and sustainable market linked development

3. Geographic Focus

The integrated research will focus on crop livestock systems in the Ethiopian Highlands. These systems encompass a wide diversity of crops (cereals, legumes, root crops) and livestock holdings (cattle and small ruminants). There are large variations in existing levels of intensification, cereal-legume rotations and other crop-combinations, as well as crop-livestock integration underpinned by factors driving intensification such as agricultural potential, access to available technologies, farmer typologies, demand for livestock products, and integration with markets across the zone. Several existing research programme sites (notably CRP1.1, 1.2, 3.7, 5) are located within this zone along with; key research stations, and the proposed priority investment area in Oromia for USAID-Ethiopia. A rich set of data layers can be overlaid to identify target locations that represent a gradient of intensity and therefore a lesson learning opportunity in relation to the project’s hypotheses. This is illustrated in Figure 1 for wheat growing areas to exemplify the sort of analyses that will be conducted using “live” GIS and expert knowledge during the stakeholder meeting to support identification of locations to represent contrasting levels of intensification to enable the characterization of different trajectories and identification of technology combinations that lead to sustainable development pathways.

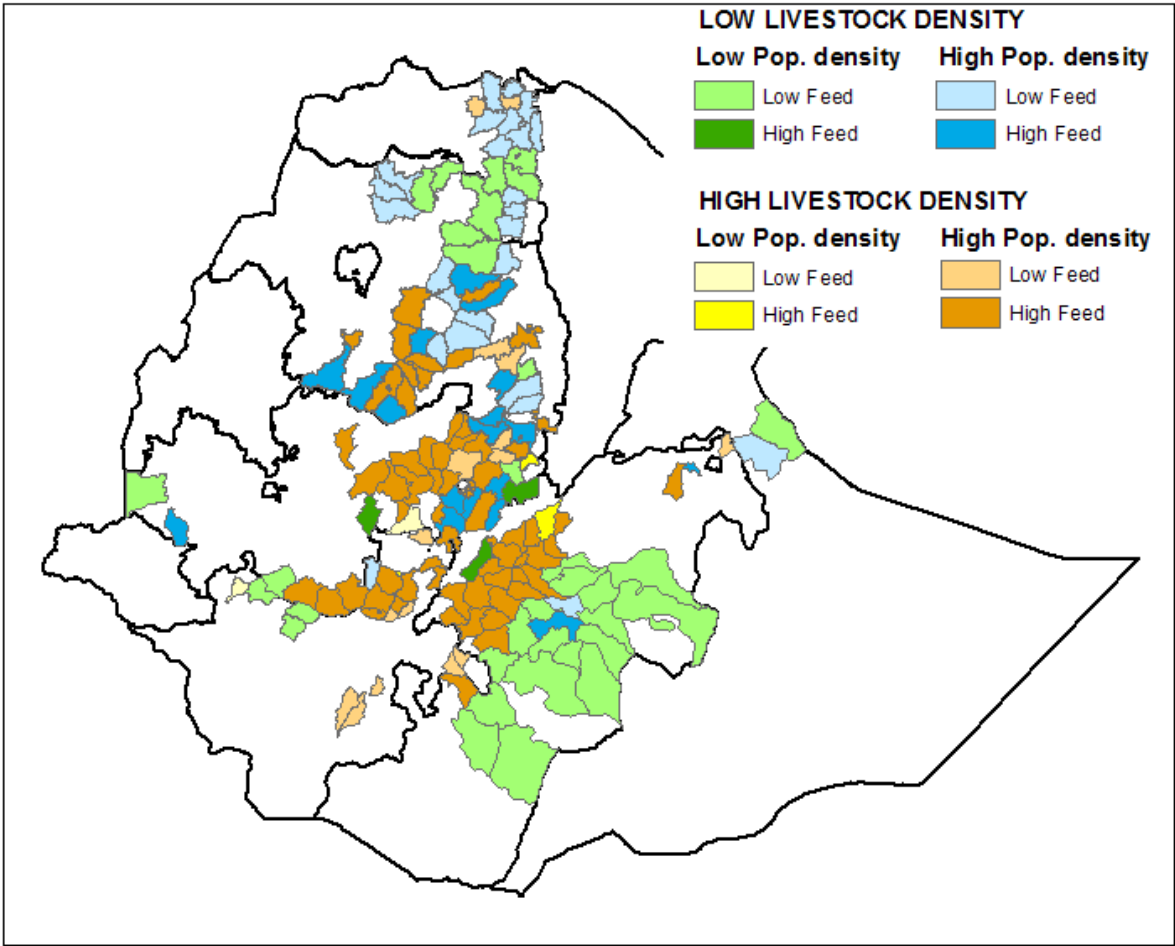


Figure 1. Potential data layer combinations applied to wheat based highland systems to illustrate diversity in terms of intensification to facilitate identification of locations with different starting points of intensity.

Apart from representing diversity in terms of intensification potential and level, the following criteria will be taken into account in this participatory site selection process:

- Representativeness
- Poverty levels

- Accessibility and proximity to research facilities (partners, national research centres, CG centres, ...)
- Institutional environment and potential for up-scaling
- Potential for impact
- Synergies with CRPs and other on-going research

Information on the above criteria will be collated from a variety of sources and available for interrogation during the meeting.

The delineation of the study sites will be done on the basis of political/administrative boundaries. The size will be large enough to encompass a range of bio-physically defined areas with contrasting farming systems and a range of social institutions. A more in-depth characterization of the study sites and the entire target zone will form part of further targeting and out-scaling during the project life. This will include a variety of data at different scales and a richer interpretation of household level socio-economic data.

4. Proposed research

The four outputs articulated below, correspond to the hypotheses listed above and will be approached in an integrated manner.

1. Trajectories and sequence of solutions for sustainable intensification of crop livestock systems with starting points of different intensity.

- o Characterisation of the farm households and farming systems including diagnostic research to identify farmer s' priorities for intensification and entry points, resource use strategies, crop-livestock integration, market access , livelihood strategies and constraints
- o Identifying household typologies for modelling crop-livestock intensification options and their potential impact on household food security and cash income
- o Description of the major drivers (at different scales) for the target farming systems including population growth, policy, institutions, market development, climate

2. Participatory research for co-development by farmers, development and research sector of solutions involving combinations of crop, livestock and natural resource management technologies

- Produce more food and feed
 - o Identify improved food feed varieties of major crops
 - o Complement varietal release procedures through addition of information about biomass and fodder traits
 - o Legume rotations and intercropping (chickpea, faba bean, lentils, haricot) to increase quantity and quality of biomass
 - o Integration of other fodder components such as forages, fodder trees
- Make better use of what is there for feed and NRM
 - o Cereal residues are nutritionally poor. Options for improving may come from increasing proportion of leguminous residues (eg through intercropping), or adding nitrogen to significantly improve utilisation – grasses, tree fodder, licks etc.
 - o Chopping to improve intake
 - o Options for combining organic and inorganic fertilizers, manures, crop residues etc
 - o Tillage and biomass management options

- Move feed around temporally and spatially
 - o Fodder trade – e.g. Trade in residues
 - o Potential for moving residues around to alleviate scarcity in deficit areas.
 - o Improved storage of residues to alleviate dry season scarcity
 - o Small scale businesses in upgrading residues through processing
 - o Increase access to high quality feed and supplements

3. *Evaluation of biophysical, economic and social trade offs and opportunities in particular at the crop-livestock-soil intersection of biomass production and use*

Bio-economic and bio-physical modelling

Prospective analysis at farm scale to look at implication of practice changes on productivity, profitability, risks and long term productivity. Identify bottlenecks for some options in term of labor, land, capital availability

- o to identify more sustainable and profitable intensification options that also increase incomes and welfare of the poor
- o identify best-bet cereal, legume, fodder, and livestock combinations that can significantly improve productivity and profitability
- o evaluate potential effects on household food security and the environment
- o identify for field validation few ‘optimal’ intensification pathways suitable for household typologies and different intensification starting points

Crop residue trade-offs

- o Assessment of major biomass trade-offs and drivers at different “nested” levels (region, village, household), including livelihood strategies and institutions.
- o Rapid assessment of the agro-ecosystem dynamics, related to land, water, soil C

4. *Identification of appropriate strategies to build the needed social capital required for responsive and sustainable market linked development*

- o Innovation platforms as catalysts of change; promoting intersections with relevant development partners, service providers, traders, knowledge sources and including USAID mission focus
- o Value chain mapping to identify actionable constraints and roles of women and men
- o Strategies for strengthening farmer coops/groups for agro-enterprise and entrepreneurship opportunities (including markets, storage, post-harvest management etc)
- o Community institutions / knowledge broking
- o Communication and knowledge sharing at community at different levels (see below)

5. Monitoring and Evaluation

The monitoring and evaluation (M&E) activities are designed to achieve a number of goals;

- **FtF Compliance:** To conform to the overarching M&E standards, best practices, and core indicators established for the entire FtF initiative
- **Open-access platform:** To deliver and maintain an open-access M&E data management and analysis platform to serve the needs of SI stakeholders
- **Backward & forward assessment:** To provide monitoring reports for *and* ex ante projections of agreed M&E indicators on an annual basis to meet stakeholder reporting and planning needs.
- **Multi-scale reporting:** To meet various stakeholder needs, and to support multi-scale analysis, the M&E platform will report at several scales; (SSA wide, site wide, country, sub-system reports).
- **Scaling-up and out assessments:** To inform planning and long-term projections of potential impact

Proposed Implementation Approach

The M&E activities will be coordinated by the HarvestChoice team at IFPRI whose spatial evaluation framework encompasses nationally representative household survey data as well as biophysical, production, market, demography and infrastructure data holdings. These elements form the core of a consistent M&E platform to be applied across not only the target farming systems within the Ethiopian Highlands megasite, but also across all three FtF Sustainable Intensification (SI) megasites in SSA. By design the current platform has a high degree of spatial and system granularity to support disaggregated examination of farming sub-systems, household types and key ecosystem services, but the need to disaggregate further or interface with higher resolution capacities of implementation partners within specific sites still needs to be established. The M&E team leader has been integral to establishing the project locations (section 3 above), meaning this is already well aligned. This core capacity will, thus, be augmented to assimilate richer location and intervention-specific data from field-based activities of the SI partners, including the conduct of specialized, supplementary M&E surveys.

Several important organizational and management principles will be adopted:

- **M&E Alliance:** A core advisory team of M&E and key stakeholder specialists to guide and provide internal review of the M&E work plans and deliverables.
- **M&E Open-Access Web-Site:** To host and make accessible SI project documents and work plans, as well as M&E technical notes and annual reports, and underpinning background publications, datasets and, wherever possible, analytical tools.
- **Annual M&E Technical Meeting:** Prior to finalization of each annual suite of M&E reports, a technical consultation will review findings and distill M&E-based recommendations. Where possible this will build on other project meetings to minimize travel time and project costs.

Analytical Approaches and Deliverables

There are at least four data and analytical aspects of the M&E evaluation capacity: (i) Delineation and characterization of target farming systems, (ii) Maintenance of a technology/intervention characterization inventory, (iii) Baseline and change assessment/projection for core M&E indicators, (iv) Change attribution. Coupled with the data management and access, report generation, and broader outreach activities, these analytical elements constitute the principal elements of the M&E logframe.

The specific details of M&E activities, outputs and responsibilities will be determined in the first three months of the project, and will largely be shaped by both technical consultation with partners (e.g. the January 2011 planning meeting in Ethiopia), as well as with donor-specific M&E, impact and attribution needs.

5. Knowledge and communication strategy

External Communication

- basic materials (online, audio, video, print) about the project and its activities – for Ethiopia and regional/global audiences (in local and international languages).
- project web site which would transition over time from reporting more on the project activities and any learning as they take place towards results and messages,
- make full use of emerging ‘social’ web communication approaches and tools (from blogs, video, to twitter and facebook) that foster interaction between the research teams and various stakeholders and audiences.

Knowledge sharing

- improve the ways that meetings (and communication processes more generally) are designed, facilitated and reported – to maximize interaction, learning and an outcome orientation.
- communication processes and approaches that capture, document and make much greater use of the tacit knowledge.
- use different and innovative ways to share and exchange knowledge with different audiences – making extensive use of ‘social’ and participatory media that give rich insights into project issues and solutions.

Publishing

- define a set of different ‘publishing’ formats for different messages, purposes and audiences. This would include a range of intermediate products (video reports and interviews, photofilms, brochures and briefs, etc) to disseminate lessons, solutions and questions as they emerge.
- We will use the existing ILRI and CGIAR-supported full text open access repository (<http://cgspace.cgiar.org>) to capture, index, publish and make widely accessible ALL products and outputs of the project.
- Information on these products would be automatically fed to project partner web services, the communication systems of the new CGIAR Research Programs (CRPs) – 1.2 and 1.2, USAID, international and national portals (Ethiopian Agriculture Portal, FAO, etc) and across the Internet.
- As part of its M&E role, IFPRI would ensure that data and documentation for M&E and reporting purposes are properly archived and made available for analysis. We have all the systems and processes in place for this.

Internal communication

- build on ILRI experiences with the Nile Basin Development Challenge project in Ethiopia to put in place a combination of face to face and electronic tools/applications to support communications across the project teams. This is likely to include electronic collaboration spaces to track agenda and activities (such as a wiki; online calendar); the document repository mentioned above; closed communication spaces (such as Yammer); email; and well-facilitated and documented project meetings (see under knowledge sharing).

7. Timeline

This proposal has a five year time horizon, details are provided for year 1. The project will aim for early engagement with communities, including through relevant development agencies to facilitate interaction and on the ground evaluation of practical options.

Annex 1. Summary of ongoing activities involving core partners with potential synergies

	CG centres involved in Ethiopian Highlands	Possible synergies
CGIAR Research Programs (CRPs)		
CRP1.1. Dryland systems. Led by ICARDA	ILRI, ICARDA, IWMI, ICRAF, ICRISAT	Research focus includes sustainable intensification; locations in Ethiopian Highlands
CRP1.2. Humid Tropics. Led by IITA	ILRI, IWMI, ICRAF	Research focus includes sustainable intensification; locations in Ethiopian Highlands
Maize and Wheat CRPs led by CIMMYT	CIMMYT	Sustainable intensification in the Ethiopian highlands through major strategic initiatives that aim to improve productivity growth and incomes for the poor in maize and wheat systems.
CRP3.7 More meat, milk and fish by and for the poor. Led by ILRI	ILRI, ICARDA (leading Ethiopia small ruminant value chain)	Small ruminant value chain priority in Ethiopia, possible synergies with sustainable production, use of crop residues for feed, especially via feed technology platform which will facilitate evaluation of crop residue quality/quantity of major crops.
CRP5 Water, Land and Ecosystems. Led by IWMI	IWMI, ILRI, ICRAF (in Nile basin sites)	Intensify farming activities, expand agricultural areas and restore degraded lands, while using natural resources wisely and minimizing

		harmful impacts on supporting ecosystems
Other projects		
SIMLESA	CIMMYT	
DTMA	CIMMYT	
QPMD	CIMMYT	
Global Rust Initiative	CIMMYT	
Tropical Legumes Project II (Phase 2)	ICRISAT, EIAR	Focused on commercialization of chickpea, now a major export crop and source of cash income in the Highlands. Has identified chickpea varieties with required market traits and appropriate management options, which have been widely adopted in the proposed medium-intensification zone. Work on legume rotations should be channelled through TL 2.
SLP feed database led by ILRI	ILRI	Use of previously developed NIRS equations for crop residues (and link to existing feed databases which are rich for Ethiopia – see http://vslp.org/ssafeed),
ACIAR feeds project	ILRI	
LIVES (Livestock and Irrigation Value Chains for Ethiopian Smallholders)	ILRI, IWMI	Dairy and small ruminants, irrigated vegetable production in priority regions
East Africa Dairy Development (EADD) project phase 2	Heifer (ILRI is a partner)	?likely to include dairy in Ethiopia
AgWater Solutions	IWMI	
IMAWESA- Improved Management of Agricultural Water in Eastern and Southern Africa	IWMI	a knowledge sharing and networking program and is funded and established by the International Fund for Agricultural Development (IFAD).
SMART-ICT	????	use of mobile phone technology to provide real time information to farmers on weather, irrigation requirements etc.
National Initiatives		
Agricultural Growth Program		
Livestock Growth Program		
Agricultural Transformation Program		
Wheat???		