

Status of Agricultural Innovations, Innovation Platforms and Innovations Investment in

Ethiopia



Program of Accompanying Research for Agricultural Innovation

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Status of
**Agricultural Innovations,
Innovation Platforms
and Innovations Investment**

Contributors to the study

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STUDY BACKGROUND

Science and technology remains the fulcrum for development over the ages. There is hardly any national development in contemporary history that is not based on consistent efforts from the science and technology sector. The state of development in agriculture follow suit; the state of efficiency in science and technology generation correlates highly with the development of agriculture. In Africa, agriculture is considered as the sector with the best potential to lead the socioeconomic development of countries on the continent. However, the sector is bedevilled with many constraints that could be categorized as technological, socio-cultural, institutional, infrastructural, and economical. The poor productivity of the enterprise stream in the sector is clearly seen from its contribution to a country's GDP versus the number of active workers engaged in the sector. Africa's agriculture currently engages about 65% of the working population and its average contribution to GDP still stands at 22.9%.

The crave to develop Africa has received good attention in recent years, starting with the political will of the heads of states, under the auspices of the Africa Union Commission, to develop and implement the Comprehensive Africa Agricultural Development Programme (CAADP), the Science Technology and Innovation Strategy (STISA). The Forum for Agricultural Research in Africa (FARA) also came up with a handful of continental initiatives, such as the Sub-Saharan Africa Challenge Programme (SSA CP), *Strengthening Capacity for Agricultural Research and Development in Africa (SCARDA)*, Dissemination of New Agricultural Technologies in Africa (DONATA) and several others. The different initiatives aim to foster change by addressing specific issues that constitute constraints in the path of progress in Africa agriculture. The notion that African agricultural research system has generated a lot of technologies with great potentials, but which are not realized due to different institutional and organizational constraints—more specifically, the way agricultural research and development systems is organized and operated—is prevalent among stakeholders in the sector. Indeed, this notion appeals to reasoning. However, there is no known cataloguing or documentation of existing technologies and their veracity in delivering broad-based outcomes. The possibility of finding some documentation in annual reports of research institutes, journal articles and thesis in the universities is known, but this will not meet an urgent need.

Thus, the Programme of Accompanying Research for Agricultural Innovation (PARI) commissioned the three studies reported in this volume to provide a compressive analysis of the state of agricultural technology generation, innovation, and investment in innovations in the last 20 years in selected countries in Africa.

Study 1 is the “situation analysis of agricultural innovations in the country” and provides succinct background on the state of agricultural innovation in the last 30 years. It provides useable data on the different government, international and private sector agricultural research and development interventions and collates information on commodities of interest and technologies generated over the years. It also conducted an assessment of the different interventions so as to highlight lessons learnt from such interventions, with regard to brilliant successes and failures.

Study 2 concerns a “scoping studies of existing agricultural innovation platforms in the country”. It carried out an identification of all the existing Innovation Platforms (IP) in the country, including identification of commodity focus, system configuration, and partnership model. The study provides an innovation summary for each IP for use in the electronic IP monitor platform. It further synthesises the lessons learnt from the agricultural IPs established through different initiatives in the country in the last ten years.

Study 3 was an “Assessment of the national and international investment in agricultural innovation”. It is an exhaustive assessment of investments in innovation for agricultural development, food and nutrition security in the country. It collates updated data on investment levels in the past and present, including a projection for the next decade requirement to assure food and nutritional security in the country.

The three studies form the comprehensive collation on the state of agricultural innovation in the 12 countries where the PARI project is being implemented. It is expected that these studies will benefit all stakeholders in Africa’s agricultural research and development, including the users of technologies, research stakeholders, extension system actors and, more importantly, the policymakers.



STUDY ONE

Inventory of Agricultural Technological Innovations (1995 to 2015)

INTRODUCTION

According to the 2015 population estimates, the population of Ethiopia is about 90,076,012, of which 72,617,000 (80.6%) live in rural areas and earn their livelihood from agriculture (CSA, 2013). Indeed, the population can be potentially one of the largest domestic markets in Africa. The country is a member of the Common Market for Eastern and Southern Africa (COMESA) and has market access to member countries. In addition to these regional markets, most Ethiopian products can enter into European Union market under the EU's Everything-But-Arms (EBA) initiative and to USA markets under the African Growth and Opportunities Act (AGOA) with market quotas and duty free products. All these market accesses are potential to the Ethiopian agricultural products, particularly to its organic produce.

Ethiopia is a landlocked country, located between longitude 33⁰W and 48⁰E and latitude 15.4⁰N and 3.4⁰S. The mean annual rainfall varies from 100mm in the northeast to more than 2400mm in the southwest. The lowest maximum temperature is recorded in the highlands, while the highest maximum temperature is in the northern parts of the Rift Valley and south-eastern lowlands of the country. The spatial patterns of relative humidity indicate maximum values in the south-western, western and north-western highlands. Low values of relative humidity are observed over the north-eastern and south-eastern parts of the country.

The country is endowed with abundant agricultural resources with immense diversity. The altitude ranges from 148 meters below sea level to 4,620 meters above sea level. Different research outputs revealed that the country possesses one of the largest and most diverse genetic resources in the world. The soils and climate are conducive for the production of a variety of food crops. The major food crops grown are cereals, pulses and oil seeds, while coffee, cotton, tobacco, sugarcane, tea and spices are the main commercial cash crops. About 72,617,000 populations (80.6% of the total population) live in rural areas and earn their livelihood from agriculture, accounting for 41% of the GDP. Coffee alone accounts for more than 60% of the total export. A total of 15% of the land mass is arable, and less than 13 million hectares of land is covered by grain crops by private peasant holdings. Nearly 55% of all smallholder farmers operate on one hectare or less (MoARD, 2010).

Ethiopian economy

The Ethiopian economy is dominated by agriculture and the service sector. Exports are highly concentrated with agriculture, with coffee alone accounting for more than 60% of the total. The economy is highly dependent on earnings from fragmented smallholder agricultural activities. The economic growth is often guided by the

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performance of the agricultural sector, which continues to be the most dominant aspect of the country's economy, accounting for nearly 43% of GDP, 85% of employment, and nearly 90% of foreign exports (MoADR, 2010). Furthermore, the majority of the agriculture sector is made up of smallholder farmers who own less than two hectares of land (ATA, 2014).

Agricultural commodities dominate the country's export, in which coffee is the principal export commodity. However, the share of non-coffee exports, the services and industry sectors in the economy, is increasing in contrast to that of agriculture, which is declining. In 2013/14, the shares of services, agriculture and industry stood at 46%, 40% and 14% respectively (UNDP, 2014). On the average, crop production makes up 60% of the sector's outputs, whereas livestock accounts for 27%, and others contribute 13% of the total agricultural value added (Gebre-Selassie and Bekele, undated). Ethiopian agriculture is dominated by subsistence, low input-low output, rainfed farming system (MoARD, 2010). For the last two decades, the country puts agriculture at the heart of its economic development by launching its Agriculture Development-led Industrialization (ADLI) strategy. This strategy puts agriculture at the forefront of Ethiopia's development process (ATA, 2014).

Challenges in Ethiopian agriculture

Agriculture in Ethiopia is mainly rainfed. Late-coming and early cessation of rainfall is cyclic. Since there is limited experience in water harvesting, these conditions highly affect the agricultural production in the country. Droughts and floods are endemic, with significant events every 3–5 years (WB, 2006). Droughts and flooding often destroy natural resources and cause failure in crop production and livestock rearing. Drought is a regular feature of Ethiopian weather pattern disrupting cropping operations, which result in reduced income from the sector and food insecurity, if it persists for a considerable period of time (Almayehu, 1993). Many of the food emergencies in Ethiopia are induced by drought. Recovery from previous crisis is cut short by the next drought.

Ethiopia recognizes two dominant agricultural systems: mixed agriculture of the highlands, where both crops and livestock production are integrated; and pastoralist agriculture in the lowlands. In areas where crops and animals occupy the same ecological zone, farming becomes a very risky business, with herds being able to compensate for localized rainfall shortages by movement to more favoured areas (Camilla, 1985). Rainfall shortage in the country affects not only crop production, but also the agrarian system. However, a given rainfall shortage affects livestock and cropping sectors differently. Ethiopia is considered as the water tower of East Africa, since its highlands are the primary source of the Nile, but suffers from chronic drought.

In 2015, the government of Ethiopia disclosed that 8.2 million people needed urgent relief aid due to delayed rains. The type, quality and quantity of tools and implements in use usually indicate the level of farming practice and agricultural development of a country. Even though there are improvements, the farming practice in Ethiopia is highly traditional, as farming tools were introduced thousands of years ago. The system is also labour-intensive and, sometimes, considered to be a factor for soil degradation (for example, soil pan formation).

Ethiopia is one of the well-endowed countries of sub-Saharan Africa in terms of natural resources and valuable diversity in the production environment. However, land degradation is a threat. The soil and water resources of the country, although still rich, are degrading quickly. As a result, soil organic matter is declining, soil nutrient is depleting, and soil depth is decreasing, leading to a decline in crop and forage yields (Dubale, 2001). Land degradation is also threatening biological resources and agricultural productivity (Berry, 2003; Mulugeta, 2004). A number of efforts have been made since the 1970s by the Ethiopian government, in collaboration with national and international organizations, for resource conservation. Even though there have been some records from the efforts, the impact of degradations on agricultural productivity remains high. The country is reported to have the highest rates of soil nutrient depletion in sub-Saharan Africa, with soil erosion estimated to average 42 tons per hectare per year on cultivated land (Pender et al., 2001).

Food security situation

In spite of the vast agricultural potential, Ethiopia has been under the state of food insecurity since the 1970s. Over the last thirty years, the country has been in the news for widespread and persistent food insecurity. Even in normal years, people in different parts of the country receive food aid. The factors responsible include land degradation, limited household assets, low levels of farm technologies, lack of employment opportunities, and population pressure (MoARD, 2009). Empirical evidence has indicated the prevalence of high level of food insecurity, with significant individual and spatial differences in the country (ECHO, 2014). The depth and intensity of food insecurity are high, influenced by poor functioning of marketing systems and other household and socioeconomic factors (Hadleya et al., 2011 and Hailu, 2012).

Around 12 million people in the country are regularly exposed to droughts, floods, landslides, epidemics and earthquakes (ECHO, 2014). These regular shocks have many negative consequences, such as forced internal displacements of population, destruction of assets and livelihoods, extreme poverty, undernutrition and extreme food insecurity. Approximately 44% of children under five years of age in Ethiopia are

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chronically malnourished or stunted, and nearly 28% are underweight. Roughly 31.6 million of the population are undernourished (USAID, 2015).

In response to the impact of drought in the country in 2015, the government called for humanitarian aid for 4.5 million populations. This emergency case did not include the number of productive safety net programme (PSNP) and other food security programme beneficiaries. Humanitarian requirements increased in the second half of 2015 as a result of the failed rains, and partly due to delays in the relief food and Targeted Supplementary Feeding (TSF) response during the first half of the year (DRMFSS, 2015).

Government efforts at reducing poverty

The government of Ethiopia, as a response to the challenges and opportunities presented above, adopted ADLI since 1995 as an overall development strategy for the country. The ADLI strategy aims at achieving initial industrialization through robust agricultural growth and close linkage between agriculture and the industrial sector. In line with ADLI, a series of poverty reduction strategies (PRSs) were launched. These included: Sustainable Development and Poverty Reduction Programme (SDPRP) from 2002 to 2005, the Plan for Accelerated and Sustained Development to End Poverty (PASDEP) from 2005 to 2010, Growth and Transformation Plan (GTP₁) from 2010 to 2015, and the current GTP₂ from 2015 to 2020. In all the programmes and policies of the country, poverty reduction is the central theme, and agriculture is given top priority, particularly with regard to smallholder farmers.

Plan for Accelerated Sustainable Development to Eradicate Poverty (PASDEP)

The main objective of the development plan (2006-2010) was to foster broad-based development in a sustainable manner so as to meet at least the Millennium Development Goals, focusing on: 1) comprehensive capacity building, 2) ensuring broad-based, accelerated, and sustainable economic development, 3) balancing population growth and economic development, 4) creating a conducive environment for women capacity development, 5) strengthening infrastructure, 6) sustainable human resource development, 7) halting the adverse impact of vulnerability and disaster on development, and 8) creating job opportunities (MoFED, 2006). During PASDEP, the country had double-digit economic growth (table 1), including the achievement of substantial agricultural growth. However, although there was reasonable progress, development activities were hindered by high inflationary pressure.

Table 1: Ethiopian agricultural growth during PASDEP

<i>Year</i>	<i>Growth indices</i>
2006	10.83
2007	11.46
2008	10.79
2009	8.80
2010	12.55
2011	11.18

Growth and Transformation Plan (GTP)

The GTP₁ was an ambitious plan to foster national economy growth in a fast track trajectory. It drew lessons from the SDPRP and PASDEP and set out the directions for economic development and the attainment of the MDGs by 2015. The objectives included: 1) maintaining at least 11% average annual growth rate; 2) expanding and ensuring quality education and health services towards achieving the MDGs; 3) establishing suitable conditions for sustainable nation-building through the creation of a stable democratic and development state; and 4) ensuring growth sustainability by fostering a stable macroeconomic framework (MoFED, 2010).

The government claimed that development in the country emanated from the effort to implement the plan in GTP. Some scholars do have concern in this regard, however, since there was not much public participation in planning process. GTP had indicated that by the end of 2015, agricultural producers would increasingly use improved institutional services, efficient marketing system, and appropriate technologies and practices for sustainable increase in agricultural production and productivity. Even though there was an increase in agricultural production, the technologies applied and the services from respective institutions were not appropriate. The system itself was not well supported through agricultural research and value chain approach. But it should not be denied that there was some improvements along the way, as Ethiopia produced some relatively rich farmers—although, other farmers still struggle with poverty (IFPRI, 2010).

Agricultural research development in Ethiopia

Even though the history of agricultural research in Ethiopia dates back to the 1950s, institutionalization of agricultural research at the national level was made in 1966 with the establishment of the Institute of Agricultural Research (IAR) (Seme and Debela, 1990; Tsedeke et al., 2004), now the Ethiopian Institute of Agricultural Research (EIAR). The government of Ethiopia has given relatively due attention to the development of agricultural research. This can be attested to by the budget allocated to the sector and the incentives being given to research staff. Since 2003, the budget allocated to the agricultural sector per annum has been more than 10%— in line with

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CAADP's threshold of 10%. Despite this progress, however, the agricultural system is characterized by low productivity. The average grain yield for various crops is less than two tons per hectare (Byerlee et al., 2007). Even though the livestock subsector plays an important role in the country's economy, productivity is decreasing as a result of poor management systems, shortage of feed and inadequate healthcare services (FDRE, 2010). The majority of smallholder farms depend on animals for draught power, cultivation and transport of goods. Sometimes, this is associated with the very poor linkages between agricultural research and extension services.

METHODOLOGY

The data collection was undertaken using in-depth review of related literature and up-to-date performance reports on agricultural innovations. Published articles and books, reports from government and non-government organizations, archives of stakeholders' organizations and some media reports (print and electronic) were also explored. In addition, key informant interviews were conducted at the Ministry of Agriculture, EIAR, ILRI, ATA, regional Bureau of Agriculture, PROLINOVA, LIVES, and regional agricultural research centres, as well as among other knowledgeable people in government and non-government organizations. In addition to face to face interview, telephone interview was also explored, since the database system in the country was very poor. Moreover, case studies were carefully reviewed for successes and failures and these were selected in consultation with experts from EIAR and the Ministry of Agriculture. The data collected from the different sources were triangulated and qualitatively analysed. The general problem of poor documentation in the country was, to a large extent, a constraint— there was no existing database on agricultural innovations in Ethiopia.

RESULTS

Agricultural Innovations in Ethiopia

Different factors limit the contribution of agricultural extension to the growth of agricultural output and productivity. Some of the most important factors are: poor linkages and lack of synergy among key actors in agricultural extension services, inadequate research outputs on the felt needs of farmers/pastoralists, poor state of infrastructure, lack of tailor-made advisory services, and shortage of financial resources (Tilahun, 2008). Non-government organizations play an important role in community-based development. They are an important feature of Ethiopia's agricultural innovation system, since they invest heavily in sustainable agriculture and rural development in the country.

In Ethiopia, innovations tend to follow a linear path of supply-driven technology dissemination through the public sector (Mikinay, 2013). As a result of this, agricultural innovations are not well developed to support the livelihoods of the population, particularly smallholder farmers. The social networks of actors in agricultural activities do not consider the nexus approach, and they are poorly interlinked. ADLI and GTP highly support the integration of actors within and between government, non-government and private organizations.

Table 1: Some NGOs in agricultural extension and advisory service provision

<i>Major NGO</i>	<i>Major areas of extension service</i>
SG-2000	Introduces diversified and innovative agricultural technologies and approaches to the FTCs, builds development agents’ capacity to enhance crop productivity, postharvest handling and processing, public-private partnership and market access
Oxfam (international)	Improving food and income security through better access to production technologies and sustainable markets, especially for women and by facilitating private and public sector engagement to enable access to markets
SelfHelp Africa	Scaling-up agricultural production and developing new enterprise and market opportunities for farmers and rural households
World Vision	Providing information and technologies to improve household food security status, resilience to shocks and recovery from disasters
Save the Children	Providing technologies and information to reduce chronic food insecurity households. So far, it has been able to: support households to cope in times of hunger; increase incomes for vulnerable households; improve management of natural resources; strengthen early warning systems; and improve disaster risk management
CRS	Through providing information and capacity building, CRS works towards building individual and community assets through non-food aid in the form of agriculture, livestock, health, nutrition, and water and sanitation assistance. It also provides livelihoods support to farmers and entrepreneurs, promotes gender equality, mobilizes for immunization and mitigates the impact of HIV
REST	Providing information, technology and resources to improve household level livelihoods and integrate this with improving the health and education status of the people of Tigray Region
Agri-service Ethiopia	Providing information, technology and training to build and facilitate community learning and action, strengthening community based institutions, improving smallholder market access, improving food security and livelihood options.

Source: Kassa Belay, 2015.

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ADLI supported several innovativeness in the agricultural sector for increasing productivity, with improved value chain initiatives for reducing poverty. It was also in favour of farmer's innovation and scaling up of such innovations. Even though ADLI clearly indicated the importance of innovation in transforming agriculture in the country, the innovation system was constrained by several factors. Designing and implementing policies to create and strengthen formal organizations (which include universities, research centres and private organizations) engaged in innovation processes were some challenges. Other challenges concerned linkages (network between and among actors), as well as the limited involvement of the private sector.

Farmers are good innovators, since they have lifelong experiences. Hence, support to the farmer professors, identifying their innovations, motivating the farmer innovators, inventory and documentation of those innovations and scaling up the innovations are important points that should be emphasized. The Ethiopian innovation system cannot sufficiently support the transformation of agriculture in the country (David and Kelemework, 2009). This is shown by the poor linkage between education, research and extension services in the country (Kassa, 2004; Gebremedhin et al., 2006; Spielman et al., 2007). It can be generally concluded that despite some forward looking policies and strategic documents in education, extension and research, the national innovation climate is poor (David and Kelemework, 2009).

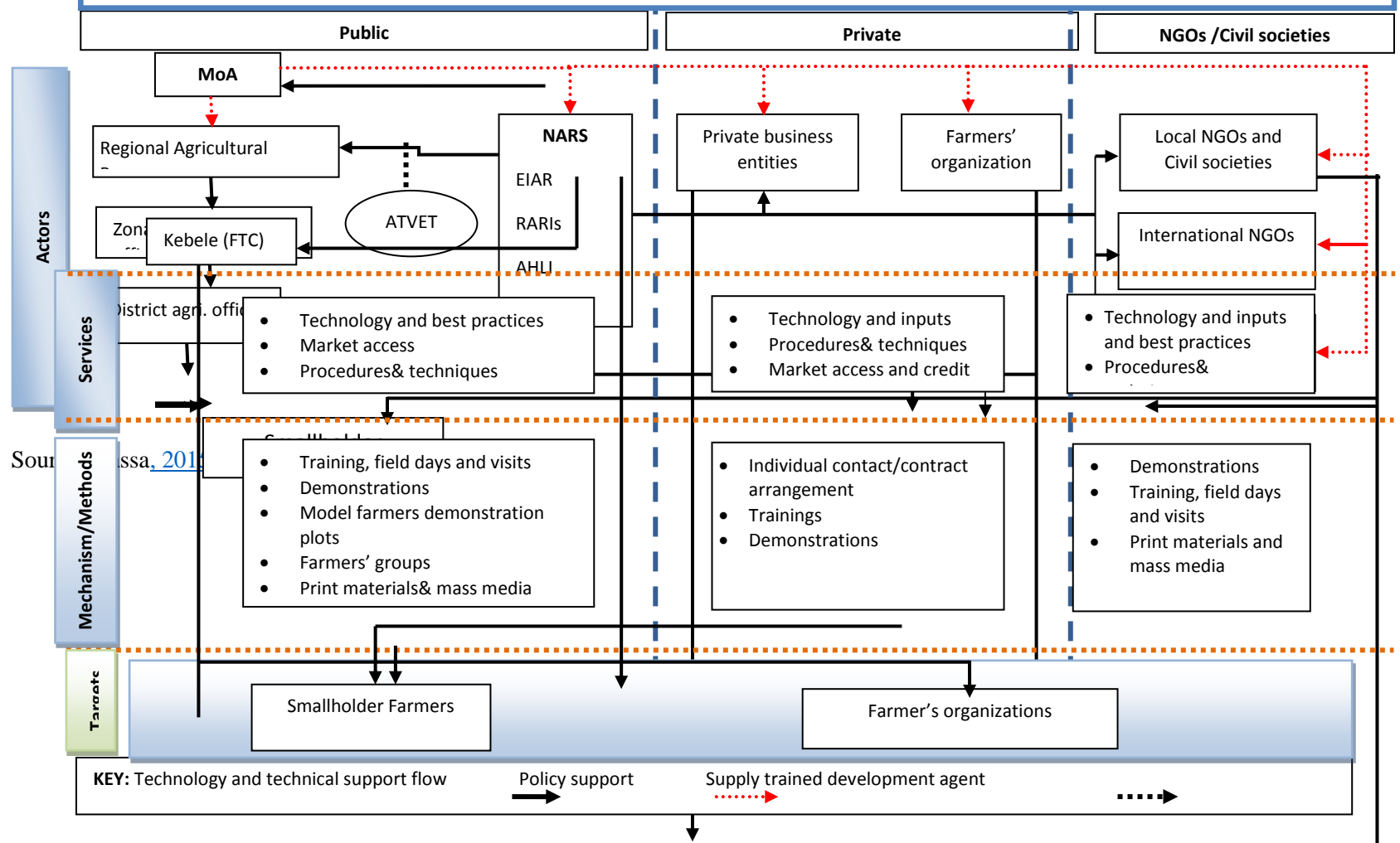
The Ethiopian agricultural sector is characterised by slow rate of technological changes and slow emergence of alternative institutional and organizational arrangements to enhance growth and development in the sector. According to the Knowledge Assessment Methodology (KAM) report on knowledge index (KI), which measures the country's ability to generate, disseminate and use knowledge, Ethiopia ranks 140th among the 145 countries assessed (KAM, 2012).

The major actors of the nation's agricultural extension system are public extension providers, which include the Ministry of Agriculture and Regional Agricultural Bureaus, along with their subsidiary institutions. But there are also diversified actors involved in the extension services; and these include regional and federal agricultural research institutions, private enterprises, agro-industries, NGOs and farmers' organizations (primarily cooperatives).

Agricultural Development Partners Linkage Advisory Council (ADPLAC) is the existing umbrella stakeholders' platform. Among the many stakeholder platforms that were tried the last couple of decades, only ADPLAC has survived till date and it serves as the institutional linkage mechanism for key agricultural stakeholders operating in the country. This platform serves as entry point for establishing AEAS country forum.

The platform is instrumental to maintaining and strengthening linkages among stakeholders and has its own structure from the federal to ward levels. It is also instrumental to the strengthening of agricultural advisory services, as it facilitates regular meeting of actors/institutions that are engaged in the delivery of agricultural advisory services throughout the country. However, the effectiveness of the platform at different levels varies considerably and is linked with several constraints (Kassa, 2015). Poor linkages among research, extension and other institutions, high staff turnover, lack of commitment among actors, limited financial resources, domination of public extension system, among others, are the constraints to ADPLAC success.

Figure 1: Map of Agricultural advisory services system of Ethiopia



Innovations in crop production

The ability of smallholder farmers to produce food is affected by growing competition for land, water, energy, and cost of agricultural inputs, which is further aggravated by the effects of climate change (Godfray et al., 2010). Since majority of the agricultural sector is made up of smallholder farmers who depend on less than two hectares of land (CSA, 2013), crop production is highly dependent on weather conditions. Thus, increasing production and productivity of the small and fragmented lands is vital. This transformation could be realized through innovative approaches.

Smallholder farmers need genetically diverse and improved crop varieties that are suited to a range of agro-ecosystems and farming practices, and are resilient to climate change to increase yield (Godfray et al., 2010). But improved seed production is not well organized in the country, and the state controls the seed enterprises. A few private seed enterprises, however, work on seed multiplication, though under the influence of centralized directives and regional autonomy, as well as the balance between state-directed control and private entrepreneurship (T/Wold et al., 2012). A total of 345 crop varieties, 188 pulse crops, 90 oil crops, 174 tubers, roots and vegetable crops; 36 fruit crops, 27 fibre crops and 36 stimulant crops were reported distributed by 2014 (MoA, 2014). But performance of the national seed system, which ensures access and use of the seeds of improved crop varieties, is still very poor (Adefris et al., 2012).

Extension services in rural Ethiopia are important systems in the country. The rise in production at country level is attributed to the support from the system. There is a significant difference between the amount produced from a hectare of land now and that of 10 years ago; and a lot of farmers have benefited from this progress. But a number of farmers are still dependent on food aid from the Productive Safety Net programme and other food security programmes. Even though the country has a strong vision for agriculture in its ADLI, through the GTP2 project, the farmers are still subsistent. During a shock from natural hazards, farmers who graduated from the Safety Net Programme are now being targeted in emergency support projects. Research centres have been conducting a number of studies on seed varieties. These centres, however, have not been able to integrate their development activities for long. As a result of this, the recommendations and potential innovations from such studies stay on the shelf. The government only recently took the initiative to integrate both for sectoral transformation.

Innovations in animal production

Ethiopian livestock are critical element of rural and urban life, and the economy in general in increased production of food. They provide direct cash income; hence, they are living banks for many farmers. They are thus critical to agricultural intensification,

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through the provision of power and manure for fertilizer and fuel; they are closely linked with the social and cultural lives of millions of Ethiopian farmers and pastoralists. The sector contributes 12-16% of total GDP and 30-35% of agricultural GDP. Although the country has the largest livestock population in Africa, its productivity and contribution to the national GDP is very low (FAOSTAT, 2004). Livestock is viewed in the country as draught animals and this prevents appropriate recognition of the value of livestock to the livelihoods of the poor and its potential for poverty reduction (Michael, 2012).

The research and innovation system in Ethiopia relating to livestock is in a highly patronized system (ESAP, 2005) which ignores the capacity of farmers to be innovative and thus predisposes them to passive partnership. On the contrary, farmers/livestock-keepers are known to be spontaneously innovative, even without the support of formal research and extension services. But because they are ignored, they are labelled as being reluctant to adopt technologies disseminated through the research and extension system. The government of Ethiopia, in collaboration with other stakeholders, recently gave due attention to improving the livestock sector. Now farmers are participating in innovation projects, working with researchers, extension agents, non-government organizations and private companies—although, the system does not bring about long-lasting solutions to the sector. The livestock market is improved and farmers get information through well-organized market information systems. Improved varieties are being introduced and veterinary services are relatively available.

The increasing national population has affected grazing lands and its impact is becoming visible both in pastoral and mixed farming communities. This has led to the introduction of ‘cut and feed system’, as well as the promotion of animal feed production in different systems. The sedentarization of pastoral communities is also limits access to grazing land for nomadic farmers. Area closure, which helps rural communities protect natural resources from degradation, is being implemented throughout the country, with some differences among regional states. The efforts made by the different actors brought some changes in the livestock and other animal production sectors, but the contribution of the sector to improving the livelihoods of farmers is almost insignificant when compared to its potential. Therefore, innovations are critical to improving the productivity of the livestock sector in general.

Innovations in natural resources management

Ethiopia is considered rich in its natural resources. As the population pressure increases, its resources become depleted. In response to the resource depletion, local people have been innovating conservation mechanisms. Their lifelong experience in

conserving resources is found to be important. Different types of terraces, forest conservation, fallowing, etc are part of the list. Since there has not been a proper balance between traditional conservation and depletion of resources, the latter often leads to degradation and, hence, productivity loss. It is nearly four decades since modern technologies in land management have been introduced to conserve natural resources and implemented, at least in an organized manner, by the ministry of agriculture. A lot of money has also been invested in the activities. But despite all the efforts, sustainable land management has still not been achieved (MoARD, 2010).

SUCSESSES AND FAILURES OF INNOVATIONS

Agriculture Hotline Service

The Ethiopian Agricultural Transformation Agency (ATA) is an initiative of government established in 2011. The primary aim of the Agency is to promote agricultural sector transformation by supporting existing structures of government, private-sector and other non-government partners in the agricultural sector. The mandate of ATA is to support the implementation of targeted interventions that will have immediate impact on agricultural productivity. To this end, the agency initiated the hotline service to provide advice to farmers. Before this time, there was significant time lost, as information on agronomic practices trickled down from research institutions and government bodies to smallholder farmers. ATA identified the use of an ICT platform to streamline the provision of tailored, real-time information directly to smallholder farmers (ATA, 2014a). The agency’s motto is “innovations to help our country grow.”

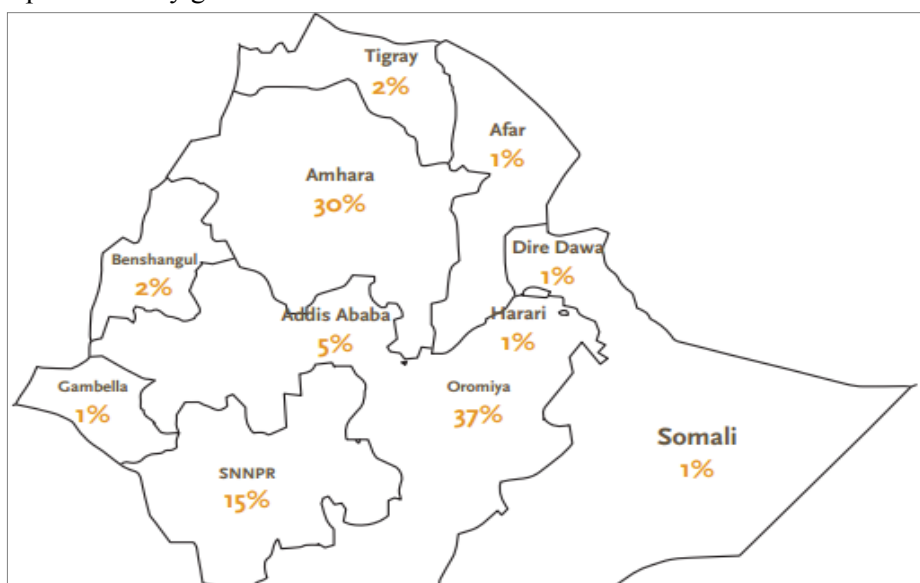


Figure 2: Volume of Callers by region

Source: <http://www.ata.gov.et/wp-content/uploads/8028-fact-sheet.pdf>

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The hotline service, launched in February 2014, provides free agricultural advice on planting crops, using fertilizer and preparing land. It is part of the government initiative to turn subsistence farmers into surplus sellers. Smallholder farmers have access to a highly popular agricultural hotline, which provides free agricultural advice. The project is a collaborative effort of the Ministry of Agriculture, the Ethiopian Institute of Agricultural Research (EIAR), Ethio Telecom and the Ethiopian Agricultural Transformation Agency (ATA). It is a call-in system on 8028 and the first of its kind in the country. The hotline is revolutionizing traditional agricultural extension services by providing smallholder farmers with direct access to advice on best agronomic practices. This system receives support from development partners, such as the Royal Netherlands Embassy and the Department of Foreign Affairs, Trade and Development Canada (DFATD).

The hotline currently provided free access to information (Interactive Voice Response (IVR) /Short Message Service) on cereal, horticulture, and pulse and oilseed crops, as well as a wide range of general agriculture-related activities. There were more than 90 lines taking an average of 35,000 calls a day (ATA, 2014b). Within 6 months of its launch, the system handled approximately 3 million phone calls from over 500,000 registered callers. On the average, the system received 176,431 new and 879,573 return calls in a month. Of the total number of callers, 86% were farmers, 5% were development agents and 2.2% were agricultural experts. Women made up 19% of total callers. The project aimed at increasing quality products and devising “value chain” strategies for each key crop. The service was available in three of Ethiopia’s main languages: Amharic, Oromiffa and Tigringa. The responsible agency, ATA, worked closely with the Gates Foundation, the Netherlands Embassy in Ethiopia and Canada’s department of foreign affairs, trade and development.

The service is very helpful, since it comprises real-time advice for farmers and development agents in their own languages. Previously, farmers only got such advice from the development agents, who needed periodic engagement of farmers with the DAs.

Agricultural Insurance

Agriculture in Ethiopia is rainfed-dependent, hence highly prone to droughts and floods. Given that 85% of the population depends on smallholder agriculture, weather shocks severely affect the overall economy of the country. The land belongs to the government and the farmers who are hit by drought and flood are not able to get credit from banks, since they do not have enough property for collateral.

Consequently, Nyala Insurance Company, one of the leading private insurance companies in Ethiopia, introduced two types of crop insurance: multiple-peril crop insurance (MPCI) and index-based weather insurance, each designed to meet the needs of different farmers. Nyala's MPCI, introduced in 2008, is a double-trigger scheme that insures farmers against a number of shocks (both natural and human induced) that affect crop yields, including shortages of rainfall, excess rainfall, fire, and transit risks. Owing to this insurance against a number of risks, MPCI is better suited to farmers who face different risks in crop yields. Actors in this innovation are:

- i. Agricultural experts from Nyala Insurance Company,
- ii. Ministry of Agriculture,
- iii. Cooperative unions,
- iv. The insured farmers.

Nyala's index-based drought insurance (introduced in 2009), on the other hand, is more suited to smallholder farmers in more drought-prone areas. A weather index product was designed in collaboration with the World Food Programme (to determine the rainfall requirements of haricot beans and installation of automated weather stations in the insured areas) and with Oxfam-America (in using satellite data), UNDP, Swiss Re and FAO. The weather index-based insurance product simply uses such measures as rainfall, temperature, and soil moisture to insure against drought or other related risks. This approach reduces operational costs, making insurance more affordable and accessible to smallholder farmers. For the weather index generation, the main growing season is split into three phases for each crop: germination and vegetative phase, flowering and seed formation, and ripening. These phases are further split into 10-day periods (dekads). The amount of rainfall needed and expected in each dekad is estimated. If the amount is lower than the pre-agreed amount, the insurance company pay the amount estimated. In this regard, the microfinance institutions and/or farmers cooperatives play an important role. Beneficiaries of the weather index insurance are: Boset Woreda, Lume-Adama Farmers' Cooperative Union (LAFCU) (eastern Ethiopian), Kola Tenben and Adi Ha Woreda (northern Ethiopia).

Moringa value chain

Moringa is known in many parts of the world for containing several nutrients (essential amino acids, vitamins and minerals) which are necessary for healthy and productive life (Barminas and Milam, 1998). There are more than 13 species of moringa in the world, of which *Moringa stenopetala*, referred to as the African moringa tree because it is native only to Ethiopia and northern Kenya is highly important in the market. The plant is one of the least traded commodities in Ethiopia and the level of consumption is restricted to a few areas of the Southern Region.

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In southern Ethiopia, the leaf of the plant is used as a substitute for cabbage in the local diet. It is also used as animal feed. Moringa was commonly known only in the Southern Region. A few years ago, this tree was known only in Konso area and its supply was limited to the village markets without any value addition; hence, it was not commercialized. Consequently, the Forestry Research Centre of the Ethiopian Institute of Agricultural Research (EIAR) established moringa value chain. The Centre identified three components in the value chain:

- **Production:** in this component, a group of farmers played a producer's role and continuously supplied raw moringa leaf to processors.
- **Processing:** A group of women and unemployed youth were identified from the urban areas and given intensive training on moringa collection, drying, processing, packaging and marketing, with all precautionary safety measures.
- **Consumption:** A series of awareness creation was made through the distribution of leaflets, using media and through exhibitions with information on utilization.

The commercialization of Moringa production targeted women as beneficiaries, providing them with income generation and self-employment opportunities. Accordingly, the value chains were implemented by establishing producer groups in the areas/districts which had no previous experience on utilization of moringa. Alamata District of the Tigray Regional State, Shoa Robit and Kewet Districts of Amahara Regional State were pilot districts for intervention. As a result of the effort made in the intervention districts and other non-intervention regions of the country, the production and utilization of moringa went high—for example, the current price of one kilogram of moringa powder is 300 Br.

The project is considered successful, having met its predetermined objectives of commercializing moringa production in Ethiopia. Women benefited the most from the value chain, as there was increase in self-employment and average income of women (their income reaching 1500-3000 Br/month) (Kaleb, 2014). The institute established the value chain with the following model approach.

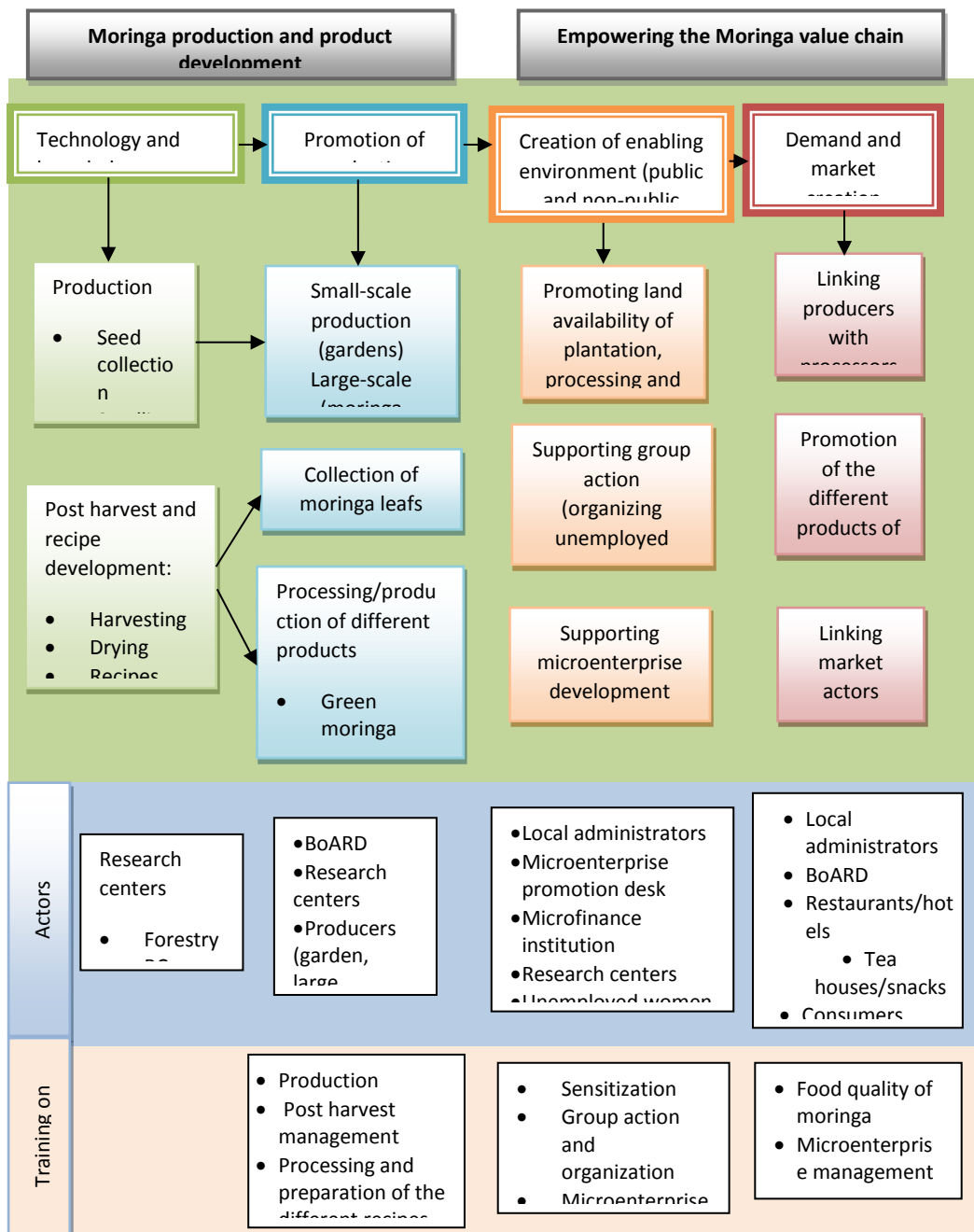


Figure 3: Moringa value chain (Source: Kaleb, 2014)

Silk production

Sericulture in Ethiopia is an agro-based industry initiated jointly by the nation's Institute of Agricultural Research and Ministry of Science and Technology in early 2000s (Metaferia et al., 2007). The constraints for success of the innovation were identified by different researchers. The major silkworm rearing constraints in Eastern Tigray were lack of food or host plants and drought; lack of modern housing, market availability, support from government and nongovernment organizations, and silk worm production materials; as well as fluctuation in seasonal environmental conditions (Assefa, 2014). In Amhara Regional State, absence of market information, scarcity of land for feed production and housing, high labour cost and scarcity of silkworm and feed seeds are identified as limiting factors (Tesfa et al., 2014).

The major stakeholders in Amhara Regional State were Bureau of Agriculture and Rural Development, Bureau of Education and TVET commission, Amhara Regional Agricultural Research Institute (ARARI), Bahir Dar University, and small and micro-finance offices. One major problem with regard to sericulture is the inability of these actors to accomplish their tasks and responsibilities. The value chains were not properly studied; the farmers were not well trained; and Woreda experts were forced to dump the technology, instead of demonstrating for its importance. Since farmers were not adding fertilizers to castor tree mulberry, the nutritional quality and yield of the mulberry leaves were not suitable for silkworm rearing. Japan Association for International Collaboration of Agriculture and Forestry commented that sericulture situation in East Africa is just the dream of acquiring foreign currency and cash earnings through export to foreign countries, without any clear thought of consumption needs or target consumers, and without considering the quality, price and design of the cocoons, raw silk and fabric that should be produced (JAICAF, 2007).

Cooperatives were organized in the beginning, hoping there would be good market in and out of the country. But the sericulture cooperatives (for example in Shebedino and Lemo districts, Southern Ethiopia) failed because of a very limited market access (Tekalgn, 2012). In the southern region, this study found that BERE Sericulture Plc was buying raw silk for a maximum of 100 birr per kilogram. After it is processed, the company sold the products to Sabahar (Handmade Ethiopian Textile Company) for 884 birr per kilogram on the average. Getting fair price is also common in most parts of the country.

During the introduction period, farmers were told they would get more money from the sale. But the products were not always available and, where available, the prices were not fair. Moreover, the value chain was not properly managed; hence, the organized groups shifted to beekeeping and horticulture. The Amhara Bureau of

Agriculture currently has no budget for sericulture; the innovation failed in that region. In Tigray and southern regions, however, some activities are still being undertaken. Melkasa Agricultural Research Centre and Alage TVET are supporting sericulture activities through training and research.

Conclusion and Recommendations

The current government of Ethiopia trained (in Agricultural Technical and Vocational Education and Training Colleges (ATVETs)) more than 60,000 development agents who are serving in the agricultural extension systems. FTCs (farmers training centres at each Kebele, the lowest administration boundary) have been constructed since 2002. The investment in FTCs was huge, estimated to be over 50 million USD, which is almost 2% of agricultural GDP between 2004 and 2009 (Spielman et al., 2010). In addition, non-state actors (private companies, local and international non-government organizations, cooperatives and others) have made concerted efforts towards ending poverty in Ethiopia through improved agricultural practices based on innovations. Some NGOs became agents of development, delivering extension services to resource-poor farmers in areas not serviced by public extension providers (Kassa, 2015).

Universities and research centres in the country are expanding work on need-based research. Though the integration among different research works and extension services has not been well coordinated and duplications of activities are common, efforts are being made by non-state actors and the government to bring about changes through innovations in agriculture. But these efforts notwithstanding, the rural population still practises subsistence. These actors seemed to have been short-sighted, ignoring indigenous knowledge when introducing technologies, and forgetting, in some cases, local contexts. Some of the technologies introduced failed because of the extension approach used. Sericulture and rainwater harvesting are examples of such failed technologies.

However, there were a few successes; with some innovations promising positive changes in the livelihoods of rural people. Such innovations are the agricultural insurance system by Nyala Insurance and agricultural hotline service by ATA (Agricultural Transformation Agency). Based on this assessment, the following are recommended:

- i. Ethiopian agriculture is rainfall dependent; hence, drought often make millions of citizens to starve. The government should invest in sustainable water resource management in an innovative way to transform agriculture. This could include: rainwater harvesting, drip irrigation, and shallow well construction for small-scale irrigation agriculture.

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- ii. The integration among research centres, universities, non-government organizations, and community-based organizations is loose. As a result of this the research and extension system is poorly integrated. Therefore, mechanisms should be devised to strengthen Agricultural Development Partners Linkage Advisory Council (ADPLAC). But the dominance of public extension services should not mask NSAs.
- iii. This study has identified some knowledge and skill gaps among experts at national, regional, zonal and district levels. Therefore, staff capacity building should be given at each level. ADPLAC, EIAR, Ministry of Agriculture and non-state actors should also focus on the identified gaps.
- iv. The rural poor are still struggling with subsistent agriculture. To alleviate their suffering, demand-driven pro-poor innovations should be developed and deployed and they should take cognisance of indigenous knowledge. Thus, innovations and their subsequent scaling up, as well as innovation databases should be developed and managed through collaboration among state and non-state actors.
- v. Ethiopia is first in livestock production in Africa, but the number of livestock is decreasing due to feed shortage. The country should, therefore, focus on quality livestock production for export, both in the area of meat and hides and skin. The country should build on the accomplishments of ILRI and other international and local organizations to pursue such a lofty objective.
- vi. Ethiopia's rich natural resource base is gradually degrading. There is the need for the country to invest in the conservation of natural resources, including those in agro-ecology to transform its agriculture.
- vii. Some extension services do not consider the value chains of certain commodities; hence, some agricultural innovations have failed despite their potential. Therefore, the value chains of every commodity should be developed and implemented accordingly. The moringa value chain was effective because the research centre which started it implemented it effectively.

STUDY TWO

Inventory and Characterization of Innovation Platforms

INTRODUCTION

Agriculture in Ethiopia is heavily reliant on rainfall. Productivity and production are strongly influenced by climatic variability, as reflected by the late coming and early cessation of rain, droughts and floods. As a result of these, significant parts of the country are characterized by persistent food insecurity.

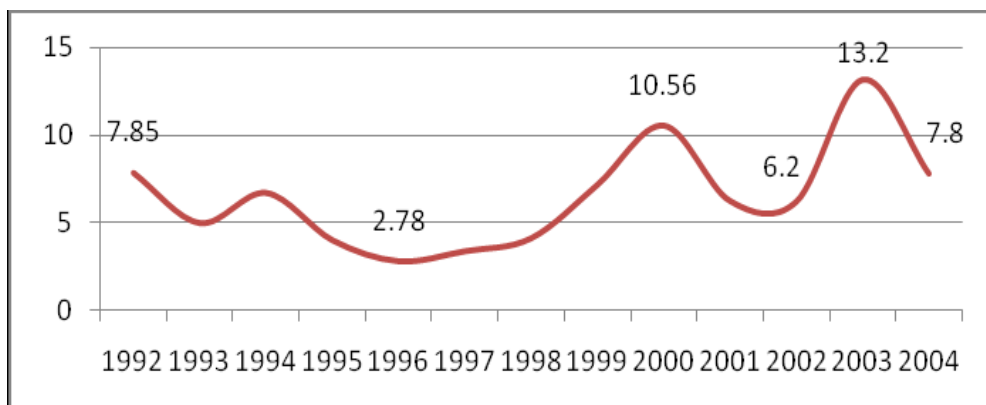


Figure 4. The number of people in need of assistance (MoARD, 2009)

Agricultural intensification and transformation should be taken as a key task in Ethiopia. An official report from the government indicates that there were continuous growths for the last ten years. But farmers are still subject to climate variability. In 2015, the number of people in need of emergency support was about 8.2 million (15 million according to the humanitarian organizations). This could not have happened if there was strategic thinking, and food security was achieved, as indicated in the official report. It indicates that the farmers are still dependent upon rainfed agriculture.

Table 1: Prevalence of undernourishment in the World and Ethiopia

Countries	Number of people undernourished in millions					Proportion of undernourished in millions				
	1990-92	2000-02	2005-07	2009-11	2012-14	1990-92	2000-02	2005-07	2009-11	2012-14
World	1 014.5	929.9	946.2	840.5	805.3	18.7	14.9	14.3	12.1	11.3
Africa	176.0	202.5	205.3	211.2	214.1	33.3	29.8	26.5	24.4	23.8
Ethiopia	37.2	37.4	34.7	33.2	32.9	74.8	55.0	44.3	38.1	35.0

Source: FAO et al. (2014)

As indicated in table 1, the undernourishment in Ethiopia is far beyond the Africa and World average, though the numbers are decreasing. The agricultural growth recorded in the country for the last 10 - 15 years will be very difficult to sustain, since the country is highly dependent on rainfed agriculture.



Figure 5. Undernourishment in Ethiopia (source: World Bank, 2015)

In reducing the high prevalence of rural poverty, the government of Ethiopia has taken measures towards increasing productivity for smallholder agriculture. It recognizes the importance of the smallholder sub-sector. The agricultural productivity enhancement for smallholder farmers is believed to help farmers graduate from purely subsistence farming. In bringing the intended objectives, there needs to be an enabling environment and a good working culture. The culture of working together in Ethiopia is not so strong. The social network among organizations has been found to be poor (Stein et al., 2014). Researchers found that there are policy conflicts among governmental organizations, sometimes even within an organization. When an office plans for a fiscal year, most of the time, it does not consider the other important stakeholders which will support or hinder its performance. The government has been trying to create platforms to improve the situation, but not in a coordinated manner. As a result, changes are not visible.

Innovation platforms (IPs) are vital to change in the agricultural sector. It helps stakeholders to work together for agricultural intensification. The IPs are composed of a range of actors, often with very different backgrounds, who discuss and address challenges and opportunities around a particular issue or area (Nederlof et al., 2011) in an innovative system thinking. The actors should not be dominated by the governmental officials. If the government agenda dominated the process, it is likely to reinforce the status quo, in which farmers have limited voice in the decision-making processes, and lead to a lack of engagement of the community members (Nederlof et al., 2011). But working with the government offices and local actors is very crucial, since it helps to sustain the IPs. When farmers and other relevant stakeholders are working together, their capacity would be built to the extent that they could take over

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some of the critical innovation brokering tasks after project funding comes to an end. The existing extension and research system in Ethiopia has been implemented for long. The changes brought to the poor smallholders are not encouraging. Most of the farmers are still struggling with subsistence.

METHODOLOGY

The scoping study for innovation platforms was conducted at the national level. The study focused on innovation platforms at different levels. The IPs initiated by the government and non-governmental organizations were carefully investigated. Data collection checklists were drafted by the PARI team from the 12 countries and FARA coordinators at Addis Ababa, Ethiopia. The checklist agreed upon consisted of the IP rationale, context, formation, functioning and outcomes (each of which has lists of ideas to be addressed).

The research team for this study critically discussed about the checklists and started data collection from the different sources. Data collection was undertaken from organizations using different methods. Key informant interview and focus group discussions (sometimes not more than three discussants participated) were conducted at the federal ministries (Ministry of Agriculture), Agricultural Transformation Agency (ATA), research organizations (EIAR, at national level and regional level), non-governmental organizations (like AfricaRISING team, LIVES, POLINOVA, Ethiopian Apiculture Board, etc). Relevant published and unpublished documents were collected from the internet and archives to understand the general situations and the changes that needed to be made. In addition, data were collected by telephone call. This was to access relevant data from the different corners of the country. The telephone call helps the team to verify data collected through FGD, key informant interview and literature.

Data collected from the different sources were categorized based on their classes. The classes in which the data were categorized include: 1) data related to natural resources management, 2) data related to crop production, and 3) data related to animal production. To check for consistency, the data were triangulated with each other, since it was collected from different sources. In cases mismatches exist, we tried to check the informants and discussants by telephone call for triangulation. The internet sources were very much supportive to check data consistency. Since there was no database established for the innovations and platforms, the researchers tried to browse a number of websites to search for available platforms in the country.

Finally, the innovation platforms are populated against the spreadsheet we had agreed on during the Addis Ababa PARI conference. The best innovation platforms were

selected by the impacts they brought in the intervention areas, sustainability of the IPs, visibility and IP meeting facilitation and minutes available. The researchers were challenged to identify failed innovation platforms. Since most of the platforms were established recently, their failure was not well recorded.

RESULTS

Agricultural Innovation Platforms

Agriculture in Ethiopia is dominated by traditional farming systems in small holdings. Intensification of the agricultural sector with small and fragmented landholdings becomes challenging to the government of Ethiopia, though there are some improvements. The government has demonstrated its strong commitment to the sector by allocating up to 15% of the total national budget. This amount is greater than the CAADP target. Allocation of such amount of budget by itself will not indicate the growth of agriculture unless the share of different sections in the agricultural sector is proportional and rational. It would have been excellent if the share of investment on research and innovation is not undermined. The lion share of the public budget allocation to agriculture goes into the Disaster Risk Management and Food Security (DRMFS) programme, with little left for research. This is reflected in the estimated budget allocation in the agricultural policy and investment framework (PIF).

Though it is known that innovation platforms can perform better than conventional approaches in linking farmers to markets, technology adoption, income generation and poverty reduction, the Agricultural Innovation System of Ethiopia is weak and fragmented (Spielman et.al., 2007). The existing extension and research system, dominated by the government, is not able to bring the intended changes, particularly in technological adoption. The technological adoption of farmers is very low in the country (IGC, 2012). As a result of this and some other problems, the quality of products and the market for low quality products dissatisfy farmers.

It was after the value chain development by non-governmental organizations that the farmers started to benefit from rice, potato, onion, banana, livestock, honey and beeswax products. For example; the price of one kilogram of onion and one kilogram of tomato previously were 80 and 40 cents, respectively. Now, their price is more than 10 birr each. This is because of the fact that the value chains developed and market information the system to the farmers. We can also see the case of honey products in Amhara regional state. The farmers' cooperative union in Zenbaba (which is leading the regional apiculture platform in Amhara) is working to increase the benefit to the beekeeping farmers. The case of the four districts in which AfricaRISING works, shows the significance of innovation platforms for agricultural intensification and nutrition security.

Innovation platforms help the producers, retailers and consumers achieve their goals. The discussants added that in a well-developed platform, members are free to discuss the opportunities and challenges of the agricultural system and the way to solve the problems related to the challenges and exploit the opportunities. Since it is a forum for multi-stakeholders, the whole problems in the value chain will be solved for mutual benefit. If farmers produce quality products, they get proportional amount of money, the brokers will not take much share, since farmers do have direct access to the market. This could also be an opportunity for the farmers to increase their income and build capacity to buy optimum amount of agricultural input. They will not be in short of money to buy inputs or will not delay to repay the loan they might have taken from credit and saving institutes.

Crop development experts in Amhara Bureau of Agriculture stated that farmers in the rural areas have access to credit from credits and saving institutions. Repayment of loan has been a source of disputes in the region. Since farmers are not producing quality agricultural outputs, they do not have good market and are not earning proportional amounts. As a result, it becomes difficult to overcome long-running disputes about farmers not repaying loans. Much of the time of the district experts are spent on sensitizing farmers to pay back the loan every year. In Ethiopia, the current agricultural loan repayment performance is not promising (Zelalem et al., 2013). The rural poor have begun to acknowledge the value of science as a vehicle of change (ILRI, 2011), but the agricultural research in the country has lost significant momentum in the last few years to satisfy the needs of farmers. The demands from the farmers are increasing, while the momentum to create a favourable environment for the farmer research groups (FRG) is lagging behind. The overall problem researchers noticed is related to the innovation system in the agricultural sector. Despite a vast increase in the number of extension agents throughout rural Ethiopia, their role has almost been irrelevant for the adoption process since 2009 (IGC, 2012).

The researchers were of the opinion that the innovation and innovation platforms were not properly understood, particularly in the Ministry of Agriculture and line offices. Innovation was perceived as technological input distribution and research output. It was considered as applying agricultural inputs and producing surplus food. The experiences in the country show that surplus production does not bring changes in the lives of the poor, unless its market value chain is properly designed.

Table 2: Agricultural budget and cost estimates to DRMFSS

Item

PIF cost estimates and financing plan in millions (ETB)

	%	Base	PIF Y1	PIF Y2	PIF Y3	PIF Y4	PIF Y5	PIF Y6	PIF Y7	PIF Y8	PIF Y9	PIF Y10	Total PIF	
		2009 - 2010	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	ETB m	USD m
1. Budget allocated to MoARD		10,408	11,951	13,368	14,803	16,326	17,978	19,784	21,766	23,944	26,339	28,973	195,232	11,832
2. DRMFSS	66.1	6,880	7,900	8,836	9,785	10,792	11,883	13,077	14,387	15,827	17,410	19,151	129,048	7,821
3. Agric. Research	5.8	604	693	775	859	947	1,043	1,147	1,262	1,389	1,528	1,680	11,323	686

Source: MoADR (2010)

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Table 3: Actors of the IPs

<i>Lemo District</i>	<i>Sinana District</i>	<i>Endamehoni District</i>	<i>Basona District</i>
<ul style="list-style-type: none"> • Lemo District Office of Agriculture, health office, water & sanitation office, road authority office, women affairs office, communication office, plan & finance office, admin office, land use & environmental protection office • Areka and Worabe Agricultural Research Centre • Lemo AfricaRISING coordination office • Wachemo University, • Local NGO representative (SOS) 	<ul style="list-style-type: none"> • Bale Zonal Office of Agriculture representative • Sinana District Office of Agriculture (WOA - NRM, Crops and Extension), • Livestock resource development agency, irrigation office, administration office, cooperative office rep, office of children and women affair rep, youth and sport affairs rep, water, mine and energy office, health office, Agricultural Growth Project (AGP), • AfricaRISING site coordinator, • Sinana Agricultural Research Centre, • Madawalabu University, • Local NGOs’ Reps operational in the target Kebeles (HUNDEE) • Ilu-Sanbitu and Salka Kebeles IPs representatives (Kebele’s office of agriculture head and chairman) • Oromia Credit and Saving Organization (WLQO) 	<ul style="list-style-type: none"> • Southern Tigray Zonal Office of Agriculture • Southern Tigray Zonal Administration Office • Endamehoni District Office of Agriculture, health office, water & sanitation office, Road Authority Office, Women Affairs Office, Communication Office, Plan & Finance Office, admin office, Land Use & Environmental Protection Office • Endamehoni District Cooperatives Union • EIAR, Mehoni Agricultural Research Centre • Alamata Agricultural research Centre • Tigray Agricultural Research Institute • Graduation with resilience to achieve sustainable development (GRAD) coordinator • Household Asset Building Program (HABP) focal person • International Potato Centre, Tigray coordinator • CASCAPE representative • Agricultural Growth Project (AGP) focal person • Maichew ATVT college dean • Mekelle university representative • Endamehoni Woreda AfricaRISING research site coordinator 	<ul style="list-style-type: none"> • Basona District Office of Agriculture, health office, water & sanitation office, Road Authority Office, Women Affairs Office, Communication Office, Plan & Finance Office, admin office, Land Use & Environmental Protection Office • AfricaRISING, • Debre Birhan Agricultural Research Centre, • Basona Worena District Office of Agriculture, • Debre Birhan University, • Sustainable Natural Resources Management Association (Sunarma)

Success and Failure in Agricultural Innovation Platforms

Innovation platforms in Ethiopia are not well developed. The attention given by the government is also very limited. It is through a small number of non-governmental organizations that some platforms were established, from which a number of stakeholders benefitted, particularly the smallholder farmer. The responsible agencies of the government (EIAR and Ministry of Agriculture) do not have databases of the innovations, platforms and the value chains. The indigenous knowledge is also given less attention for agricultural intensification. The researchers therefore tried to identify the potential organizations which established the innovation platforms. The following are the best innovation platforms we have identified during the data collection period.

AfricaRISING Platforms

AfricaRISING is a project focusing on system interventions in the crop-livestock-tree mixed farming system in four regions (Amhara, Oromia, Tigray and SNNPR) of the Ethiopian highlands. The project is implemented by ILRI Ethiopia. In 2014, it established 12 strategic and operational innovation platforms in selected four districts of the four regions. Four strategic innovation platforms were established at district level, while eight operational IPs were established at kebele level (the smallest administrative boundary). Kebele operational platforms oversee local research activities, foster integration among the farmer research groups, and promote alignment of local on-farm researches with district priorities. Farmer research groups (innovation clusters) were expected to expand to promote scaling of innovation to wider groups of farmers.

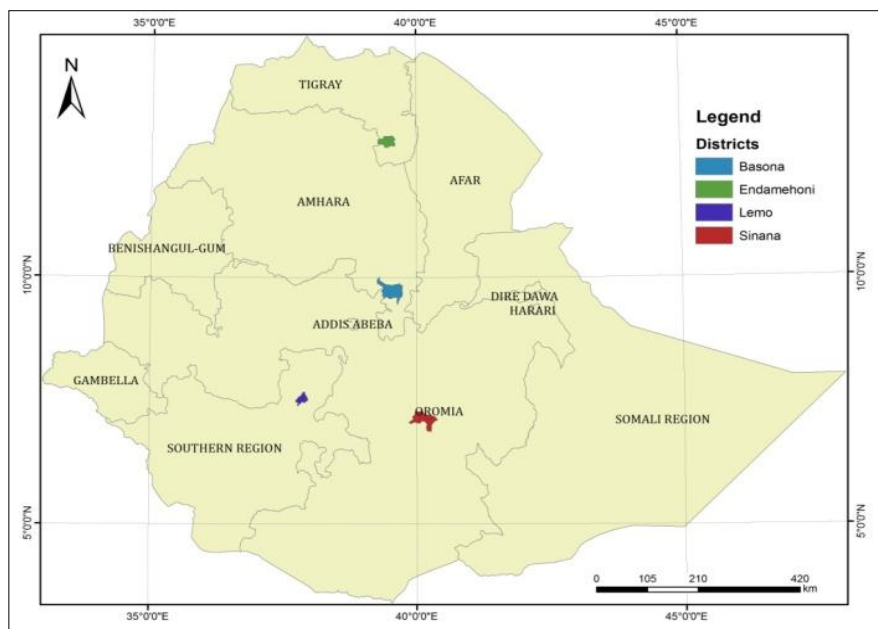


Figure 6. AfricaRISING intervention areas

Livelihoods and food security situation of the districts

The livelihoods of the four districts were diverse, according to their agro ecology, namely: crop production (cereals and vegetables) and livestock rearing (poultry, dairy farming, sheep and goat rearing and beef fattening).

Table 4. Sources of livelihood

<i>District</i>	<i>Major sources of livelihood and constraints</i>			
	<i>Major crops</i>	<i>Major livestock</i>	<i>Major constraints identified for low crop yield</i>	<i>Others</i>
Basona	Wheat, barley, faba bean, field pea, lentil, vegetables and root crops	Poultry, dairy farming, sheep and goat rearing and beef fattening	Chocolate spot on barley and rust on wheat, hail and frost, landslide, weed prevalence, erratic rainfall	Eucalyptus tree plantation
Lemo	Wheat, tef, enset, maize, potato, faba bean and barley	Ox, dairy cow, sheep, goat, poultry and donkey	Limited access to improved varieties of seed, and poor farming practices	Off farm employment
Endamehoni	wheat, barley, faba bean, field pea and lentil	Apiary, poultry, dairy, sheep and goat rearing, and beef fattening	Disease and pest prevalence, hail storm, soil erosion, limited access to improved seed variety	Non-timber forest
Sinana	Wheat and Barley	Poultry, equines, Dairy farming	Diseases and pests, weed, high cost of inputs mainly fertilizer and seed, backward farming system and knowledge, limited financial capital and fluctuating market prices	Tree plantation (not much common)

Source: adapted from Kaleb et al. (2014)

There are a number of success stories in the AfricaRISING platforms. The livelihoods of the farmers that participating in the IPs improved. Agricultural intensification through integrating crop-livestock-tree together was well introduced to the farmers. Farmers are directly participating in the IPs at the operational and strategic levels. They are participating to identify their problems according to own priority and plan for

solutions. The district IPs support the kebele IPs to focus on strategic issues. The following is a list of success stories recorded by the innovation platforms at all levels:

- Desho grass (*Pennisetum pedicellatum*) was identified as termite resistant. It was introduced as a better nutritive quality livestock feed. It was integrated with SWC structures for stabilization
- The improvements of different crop varieties (faba bean, wheat, potato, barley (for food and malt), inset) was undertaken and distributed. From the different varieties, the one with a high biomass yield was selected.
- Drought resistant crop varieties was improved and distributed.
- Farmers are aware of agricultural intensification by integrating crop-livestock and tree.
- Productivity of inset increased through integrated system of disease and pest management. As a result of this, quality inset output decreased the amount of labour needed to prepare it for food. Women were exerting maximum labour for preparation of food from inset when it is affected by disease. Nowadays, since the disease and insect problem is reduced, women's labour is not being exploited.
- Farmers become owners of improved seeds and seed store. This reduces the amount of money they were investing to buy improved seed varieties.

Challenges encountered

- Less follow up of farmers on Tree Lucerne and unsuitable micro climate
- Sheep disease on irrigated fodder sheep fattening experiment and less attention to the marketing aspect
- Bringing different stakeholders to the same level of interest in multi-stakeholder processes
- Delay in planting from planting season in some experiments (Kaleb *et al*, 2014)

Ethiopian Apiculture Platform (Board)

Beekeeping is an important economic activity in Ethiopia, engaging more than 1.7 million people (Drost and van Wijk, 2010). With approximately 5-10 million bee colonies, the country ranks tenth and fourth in honey and beeswax production worldwide. Despite the huge potential for honey production, the quality and quantity of honey which has been produced in the country is very low. According to the Ministry of Agriculture, the current national honey yield is estimated at 53,700 tons per annum (USAID, 2013), although it has the potential to produce up to 500,000 tons of honey and 50,000 tons of beeswax per year (SNV, 2005). Despite its rich endowment, diverse agro-ecology and unique natural flora well suited for beekeeping, Ethiopia's potential in honey production remains highly underexploited (Drost and van

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Wijk, 2010). Major constraints in the apiculture sectors in the country, as identified by NSV were the following:

- The sector is not given due attention, since it is considered as an off-farm activity
- High deforestation
- Limited credit access; where access is available, it is with high interest and it is often short-term and of small amount
- The extension services regarding apiculture is too general, lacks expertise
- Dependence on traditional and low technology input
- Poor pre and postharvest management,
- inadequate extension services and poor marketing infrastructure

SNV established BOAM (Business Organisations and their Access to Markets), in which the multi-stakeholder platform is aimed at improving the apiculture value chain. Taking high-quality honey demand in the international and local markets as an opportunity, SNV BOAM established a multi-stakeholder platform named: Coordination Group-CG, for the honey and beeswax value chain in 2005 (Drost and van Wijk, 2011). The CG used to meet every three months since 2005.

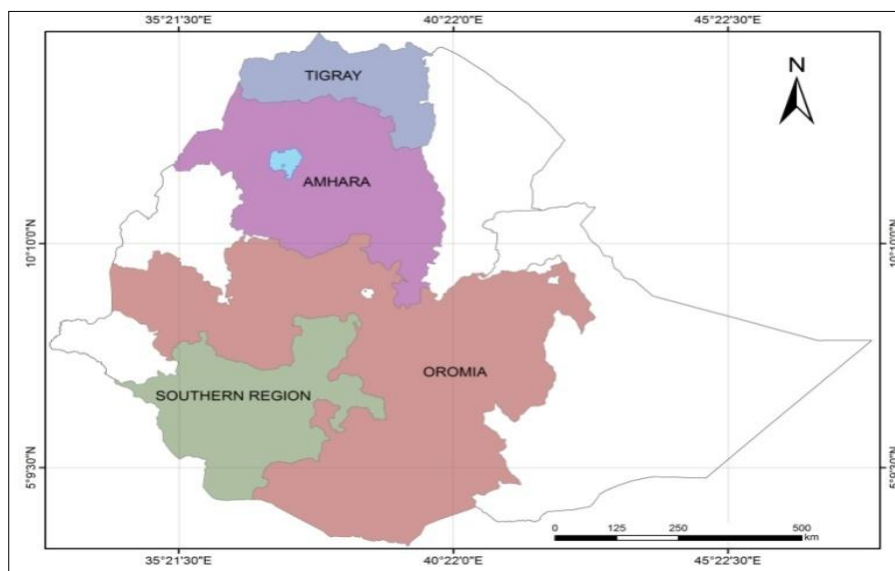


Figure 7. Ethiopian Apiculture Platform/Board intervention areas

BOAM worked from 2005 – 2011. In its implementation period, BOAM helped in the establishment of the Ethiopian Apiculture Platform/Board in 2009. During the establishment, the Ethiopian Apiculture Board (EAB) was planned to take over the CG

meetings (already in place) as the chain leader. Apiculture Scaling-up Programme for Income and Rural Employment (ASPIRE), a project from 2012 – 2017, has taken steps towards scaling up of the honey value chain to export quality table honey. The platform is working in the four major regions of the country: Amhara, Oromiya, SNNP and Tigray.

Actors in the IP

Members of the national MSP are: the Ministry of Agriculture and Rural Development, the Ministry of Trade and Industry, the Chamber of Commerce, several financial institutes and banks, the Holeta Research Centre, Bureau of Finance and Economic Development (BoFED) and SNNPR Micro and Small Trade and Industry Bureau (SNNPR MSE Agency), the Quality Standard Authority of Ethiopia (QSAE), the Consulting Management Business Creation and Development Services (BCaD), women associations at the national level, Amhara Apiculture Board, Oromiya Apiculture Board, and Tigray Apiculture Board.

Success of the IP

Though multi-factors contributed to the impacts brought in the apiculture sector, the role of the platform is enormous. Since its intervention, the market situation became improved (price of honey more than tripled and quadrupled in some cases), the amount of quality honey produced increased and entered into the international market, and technologies are being improved for quality production. As a result of these, beekeepers are benefiting from their products.

After BOAM established the Ethiopian Apiculture Platform/Board, the latter managed to handle the tasks. The Board is a platform consisting of the regional apiculture board. It is a forum in which the value chains, the quality output, the problems encountered and the benefit of beekeepers are being handled. Through time, the EAB became influential. The influence of the apiculture platform contributed to the ratification of the Apiculture Resources Development and Protection Proclamation No. 660/2009. The board helps actors to come together biannually (which, in the BOAM period, was three times per year) to learn about each other and bring the problems they are encountering for discussion.

As a result of the effective participation of actors, researches organization and the apiculture sector, there was a reduction in illegal trade, pesticide and insecticide application (as a result of awareness creation in collaboration with government and non-government organizations); the market for honey and beehives at the national and international level were accessible and quality standard issues became a concern of the

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board. Also, the Farmers' Cooperative Unions were capable of bringing their products to the international market.

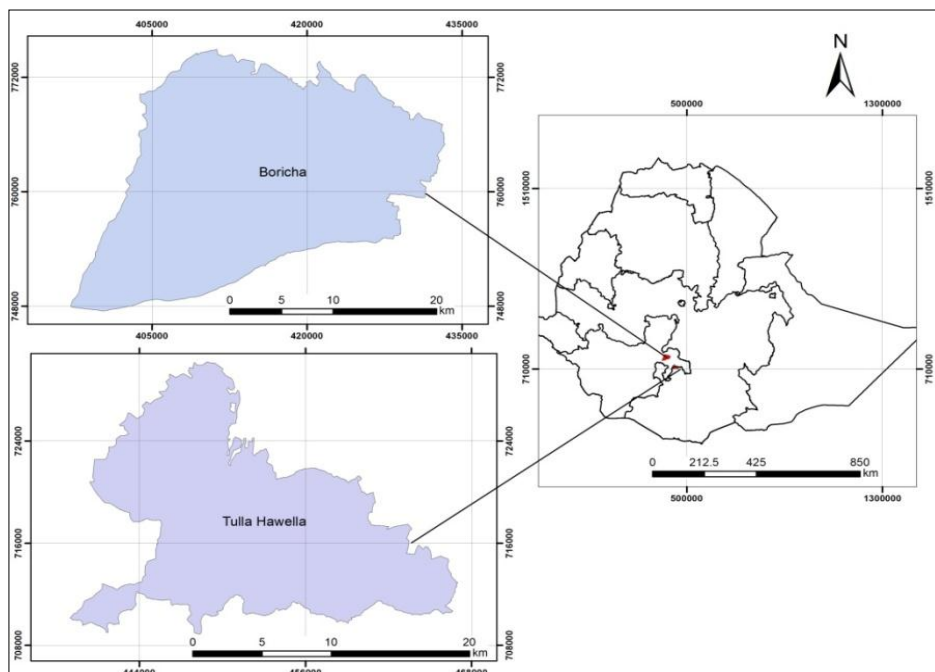


Figure 8. Location map of Boricha Woreda and Tulla-Hawella Districts

Innovation Platform for Technology Adoption (IPTA)

The IPTA was introduced in Hawella Tulla and Boricha districts. The districts are found in the Sidama zone of SNNPR (Southern Nations, Nationalities and Peoples Region). The districts were identified as food insecure, and are beneficiaries of food security programmes (like productive safety net programmes). The people experience problems of malnutrition and high food insecurity. Sweet potato is among the staple foods in Woreda. Supply of water for human consumption is poor (WHO, 2009). Vitamin A deficiency was affecting the under-five children and lactating mothers. Vitamin A deficiency (VAD) is an important public health problem in Ethiopia, just as in other developing countries. Due to lack of awareness and the cultural food habits of the Ethiopian people, the consumption of vitamin A rich food is not in sufficient quantities. As a result, infant and maternal mortality and night blindness are some of the commonest health problems in Ethiopia.

Maize, *enset* (false banana or *E. Ventricosum*), and sweet potato are the major food crops in the area. The production of sweet potato was very poor because of recurring drought, sweet potato weevil, sweet potato butterfly and the sweet potato virus disease (Tewodros et al., 2011). To overcome the challenges of the disease and insects and, hence, vitamin A deficiency in the area, the Hawassa Research Centre tried to introduce orange-fleshed sweet potato (OFSP) varieties (Koka-12, Guntute, Kulfo and Tulla) (Assefa et al., 2007). The varieties were not adopted by the farmers because of their unusual colour and taste. The government extension system was not effective enough to solve the problems encountered. The efforts made by the Hawasa Research Centre coincide with the launch of DONATA (Dissemination of New Agricultural Technologies in Africa) (Kimenye *et al.*, 2014). DONATA supported the project technically and financially.

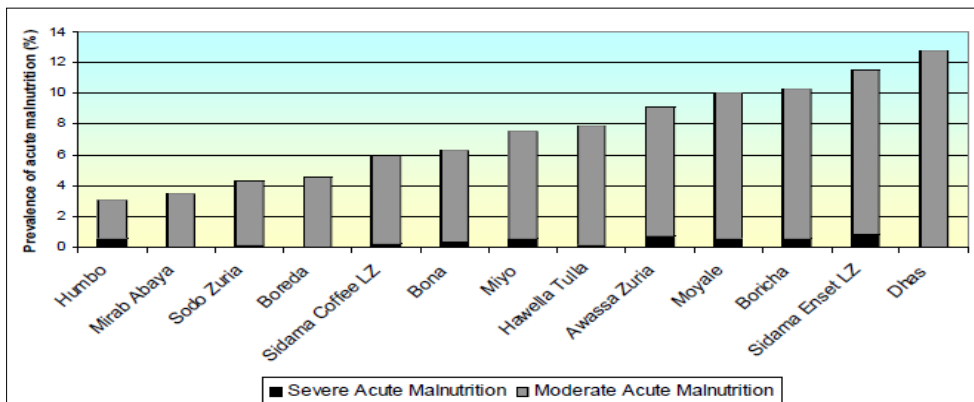


Figure 9. Nutritional Survey results in Ethiopia (source: DPPA, 2008)

IPTA Actors

Actors of the IPTA consist of governmental and non-governmental organizations at the district level. The responsibility of each actor was clearly identified. Since the relevant actors were incorporated, the IP became effective.

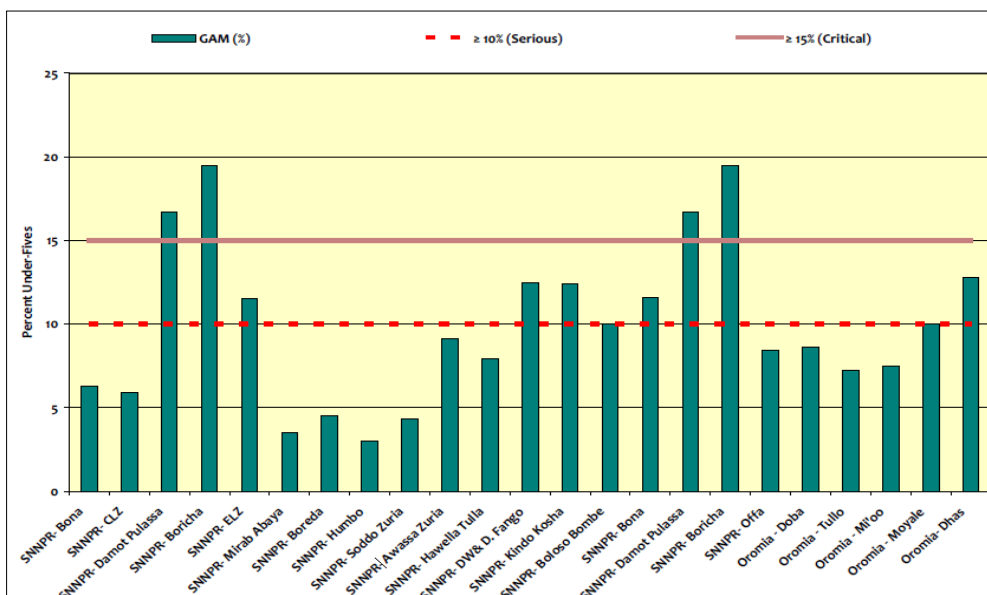


Figure 10. Ethiopia food security update on malnutrition (source: FEWSNET, 2008)

Table 5. IP actors and their responsibility

<i>Actor</i>	<i>Responsibility</i>
Hawassa and Areka Research Centres	Produce clean material through tissue culture and rapid multiplication in fields
Woreda Office of Agriculture	Extends the technologies
Representatives of farmers	Produce the OFSP varieties
Non-governmental organization (GOAL-SIDAMA)	Capacity building like supplying of clean planting material

The platform members used to meet quarterly to identify and solve problems accordingly. The IPTAs undertook learning and experience sharing visits to each other on an annual basis. The clean planting materials of the varieties were produced at primary and secondary sites under the Hawassa and Areka Research Centres. They provided to commercial vine producers and farmers training centres for further multiplication to be disseminated for farmers by extension agents of government, non-governmental organizations scheme and model farmers. Farmers received OFSP planting materials from different sources. Some received planting materials from model farmers close to Farmers Training Centres (FTC), while others received vines from commercial vine producers. In Hawassa IPTA, farmers obtained vines through the non-governmental organization, GOAL Ethiopia, who bought vines from commercial producers or SMSs using money provided by the DONATA project (Kimenye *et al.*, 2014).

Success of the IPTA

The IP disseminated information through local newspapers, FM radios, field visit days and exhibitions (both at Hawassa and Areka centres). Over 10 million OFSP clean vine cuttings were disseminated to non-IPTA operated areas through NGOs such as: World Vision, Concern Worldwide, Save the Children, Inter Aid, Vitta, FAO and the SNNPRS Bureau of Agriculture through the National Sweet Potato Improvement programme in Hawassa centre. This indicates that non-IP members were cooperative in the dissemination of clean vine cuttings. As a result of this, the IP was successful in the introduction of the technology. The success of IP could be summarized as follows:

- Sweet potato varieties cleaned of viruses (Over 30 million clean vine cuttings of OFSP varieties were produced)
- Rapid multiplication of clean planting materials of OFSP varieties in the multiplication site
- Clean planting materials of OFSP varieties successfully distributed to farmers
- Capacity of the stakeholders built
- Commercial seed enterprises developed around Hawassa IPTA (the success of the enterprise was evident in the fact that after the DONATA support was phased out, they continued to produce vines for sale)
- As a result of the intervention, the consumption of the OFSP varieties increased throughout the country (Henok K., 2015).
- Virus-clean vine cuttings of the OFSP varieties were distributed to the other regions of the country.

4. Conclusions and Recommendations

The rainfed-dependent agriculture in Ethiopia needs innovation and platforms to feed the growing population. Despite its potential for agriculture, the nutritional status of the population is far beyond the average in Africa. The government of Ethiopia has recognized the problems related to food and nutrition security, as a result of which policies and guidelines were developed to intensify integrated agriculture.

As the number of the population increases and land degradation being a serious problem, farmers started to appreciate the importance of technology and are demanding for appropriate technological innovations to produce more on a small plot of land. They are also in need of a good market for their products. Since the research and extension services in the country are loosely integrated, the momentum from the research centres and extension services are lagging behind their demand. Some of the extension approaches failed and the farmers become pessimistic of the technologies introduced along the same line of those which failed in the past.

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Innovation platforms are helping to introduce technologies, facilitate scaling up and integrate crop-livestock-tree for better production and value chain. The existing platforms in the country can be taken as spring boards to create platforms along the value chains. One of the problems identified from the literature review and discussions with experts is the lack of awareness about innovation and innovation platforms. Most of the regional bureau and the Federal Ministry of Agriculture experts consider innovation as variety development, invention of new varieties, etc. Some of the experts understand innovation, but are not active in documenting innovations, innovation platforms and the investment being undertaken on innovations. The researchers found no database regarding innovation and innovation platforms in the governmental institutions and non-governmental organizations. Within the given period of time, we have tried to identify a total of 61 innovation platforms. Out of these, 16 are on natural resources management, 33 are on crop production and 12 on livestock.

Based on the findings from the scoping study, the researchers would like to suggest the following points.

1. Emphasis should be placed on training agricultural innovation facilitators. Working with partners to enrich the curriculum of universities to include soft skills that are essential for the successful facilitation of innovation processes. The training should not be dealt with through modular training, but requires learning by doing. The agricultural research centres and universities can be potential stakeholders in this regard.
2. Building the capacity of experts without working on the institutional reforms will not be effective. Therefore, the government organization that is in charge should be consulted and trained to fill the gaps and conduct reforms if necessary. The IP system could be mainstreamed in the existing extension system and taken as key to success in agricultural transformation.
3. The knowledge and skill gaps of innovation and innovation platforms are identified as a major problem. The 44 universities in the country are stretched on a number of fields of studies and graduates are not capable in bringing about changes in this regard. Therefore, a training centre specialized on value chain, innovation and innovation platforms will be important for the training of trainers.
4. The Ministry of Agriculture does not have a database on the various innovations and innovation platforms. Therefore, to avoid duplication of activities and the wise use of limited resource, the government should be advised and supported to develop a database management system.

STUDY THREE

**Investments in Innovations for
Agricultural Development and
Food and Nutrition Security**

INTRODUCTION

Investment on agriculture is the key determinant for food and nutrition security (AU, 2003 and WB, 2007). Leaders of the African countries agreed to end poverty through investment on agriculture and increasing production and productivity. Ethiopia has been in a political regime shift for more than half a century, which directly has impacted on agriculture. As the regimes change, the focus of the governments towards agriculture changes accordingly. The agricultural system in the country is still traditional. Since there is a fragmented landholding system, a large-scale farm is almost unthinkable, except in the peripheral areas of the country, where private investments are expanding. Farmers are struggling towards subsistence. In a small plot of land they produce cash crops and rare animals, but the market for their produce has been very poor, though there have been changes in recent years.

Investment in agricultural research

Agricultural research in Ethiopia started with the establishment of the Ambo and Jimma Colleges of Agriculture (in 1947) and the Imperial College of Agriculture and Mechanical Arts (now Haramaya University) in 1953 (Bechare, 2007). But literature shows that research formally started in Ethiopia in 1966, after the establishment of the Ethiopian Institute of Agricultural Research (EIAR), formerly known as Institute of Agricultural Research (IAR) (Seme and Debela, 1990 and Tsedeke et al., 2004). Since then, the expenditure by the government for research has been increasing. The involvement of the private sectors in research in the country has been very low in the previous regimes. Some researchers argue that there is still little or no agricultural research work done by the private sectors in Ethiopia (Bechare, 2007). The overwhelming presence of the government in all areas of agriculture has limited private sector expansion in the past (Belay, 2015). Even though there are improvements, the presence of the government in a number of areas in agriculture still limits the involvement of the private sector.

There are a number of international agricultural research organizations, including the International Centre for Agricultural Research in the Tropics (CIAT), International Centre for Wheat and Maize Improvement (CIMMYT), International Potato Improvement Centre (CIP), International Centre for Agricultural Research in the Dry Areas (ICARDA), International Centre for Research in Agro-Forestry (ICRAF), International Centre for Research in Semi-Arid Tropics (ICRISAT), and International Livestock Research Institute (ILRI), which are either represented through their branch offices in Ethiopia, or collaborate with NARS through their various networks. These NSAs, which can play major roles in bringing about agricultural innovation investments, are not members of the NARS.

The investment on agricultural research has been believed to be sources of agricultural innovations and the responsibility has been mostly given to the EIAR. Recently, universities started conducting researches based on the thematic areas considered as relevant to their local conditions. Though the country is considered to have met standards outlined in the CAADP accord regarding investment on agriculture, the amount allocated to the food security sector and agricultural investment indicates that there are gaps. Of the total budget allocated to the agricultural sector, a huge amount is for food security programmes for consumption. When we consider the expenditure of the country for agricultural research and development, the share per number of the population is lower than that for most of the African countries.

Investment in agricultural innovation

Agricultural innovation is not well-developed in Ethiopia. State and non-state actors, research and community services are poorly interlinked. The investments by NSA on innovations are encouraging these days, though very low, as compared to what they are expected to invest. The government has also started investing through its universities and research institutes for agricultural innovation. Since the NARS is not well-organized and coordinated, the investments made so far did not bring about changes as expected.

Investment in agricultural extension services

Extension services in Ethiopia started in the 1950s. Since the 1970s, trained personnel were recruited to serve the rural community for better production. Post 2000, the central feature of the extension system is the deployment of DAs and the construction of 15,000 farmer training centres (FTCs). The FTCs were designed as local centres for farmers to receive information, training, demonstrations and advice from the development agents. The public extension programme, with about 60,000 development agents, makes Ethiopia's agricultural extension system the largest in sub-Saharan Africa (USAID, 2015). There are about three development agents for each kebele (one for natural resource management, one for plant sciences and one for animal production). The number of DAs and FTCs are very good achievements, but most of the DAs are not skilful and the FTCs are ill-equipped as is indicated in the design (Belay et al., 2010).

Despite the efforts, the following are the major weaknesses identified by different researchers: the top down approach in extension services which focus on technology transfer, limited attention given to subject area specialization (recently each DA is working on natural resources management, animal production and technology, and plant sciences issues), high turnover of staff and limitation in the quality of field and technical staff, lack of monitoring and evaluation of the system, limited information

management system, limited partnership with the private sector, universities, research institutes and NGOs in extension service delivery, and indigenous knowledge is not appreciated enough as a supportive knowledge to the system (Belay, 2015).

Investment in input supply

Poverty reduction in Ethiopia is almost impossible without a significant growth in crop yields for major staples. This requires improving the farmers' access to fertilizer, improved seeds, agricultural credit and other inputs. The government of Ethiopia has been taking different measures to increase the availability of improved seeds, chemical fertilizers and extension services to increase agricultural productivity. To this end, different packages have been designed since the 1960s: First and Second Five-Year Development Plans (1957-1967), Third Five-Year Development Plan (Comprehensive Integrated Package Projects) (1968-1973), Minimum Package Program I (1971-1979), Agricultural Marketing Corporation (1978), Minimum Package Program II (1980-1985), 1984 Agricultural Input Supply Corporation (AISCO) 1986-1995, Peasant Agricultural Development Program (PADEP) (Stepanek, 1999; Gebremedhin et al., 2006; Abate, 2008). The agricultural policy in the imperial period was focused on implementing the Land Reform Proclamation than on promoting agricultural extension services. In the military era, where the cooperatives and state-owned farms were the focus of the government, the individual peasant producers were largely deprived of access to credit services and improved inputs (Belay, 2015).

The present regime has introduced the Agriculture Development Led Industrialization (ADLI), said to be Ethiopia's development road map in 1992, to intensify cereal production, accelerate agricultural growth and achieve food security. In 1993, the Sasakawa Global 2000 (SG-2000) was introduced at a large-scale and promoted the use of productivity-enhancing technologies and access to inputs and credit to smallholder farmers by demonstrating at farm sites, focusing on wheat and maize. The success of SG-2000 led the government of Ethiopia to adopt the Participatory Demonstration and Training Extension System (PADETES). PADETES expands the technology packages by including livestock, high-value crops, post-harvest technologies and agroforestry by using a menu-based approach. As the services needed a large number of educated manpower, the government of Ethiopia started the Agricultural Technical and Vocational School (ATVET), in which more than 70,000 DAs get trained.

Taking the ADLI as a standing pillar, the government of Ethiopia formulated five year plans such as Plan for Accelerated Sustainable Development to End Poverty (PASDEP) (2005 – 2010), Growth and Transformation Plan (GTPI) (/2010 – 2015) and Growth and Transformation Plan (GTPII) (2015–2020). The price of agricultural

inputs increases through time, while the government subsidy to agricultural inputs decreases. When we take the case of improved seed, there are a number of constraints. Scholars pointed out the following constraints for the development of the sector: farmer saves and replants seed of an improved cultivar across seasons and, in doing so, avoids paying the private innovator who improved the cultivar, and the characteristics of the improved seeds are known only by the innovator, implying that farmers sometimes lack confidence in the variety in the market. Most farmers still rely primarily on farmer-to-farmer exchanges or saved seeds (Belay, 2004).

The ADLI strategy of the existing government has been paying very good attention to the promotion of agricultural inputs. But it is criticized for concentrating excessively on technology promotion, which the smallholder farmers do not know. The FRG is not well-developed and farmers are not informed about a technology which they intend to use for agricultural intensification in a fragmented landholding. Whatever efforts made in Ethiopia, though there are some improvements compared to the previous cases, the agricultural productivity is very low, or we can say the success is very modest as compared to the efforts made. Most of the agricultural input supply is undertaken by the government. Input supply, mostly through the agricultural offices, includes improved seeds, seedlings, agro chemicals, drugs, veterinary services, heifers, artificial insemination, credit, production and processing tools.

The average fertilizer application in Ethiopia is by far the lowest in the world, even less than that in Kenya, Ghana and South Africa (figure 1). As the cost of fertilizer increases, the farmers’ purchasing power decreases. Credit for smallholder farmers is not sufficiently available. The interest rates of rural credit and saving associations are greater than that of the private and public banks in the country. Generally, the investment on agricultural input, though generally increasing, brings modest changes in increasing productivity. But the changes required to increase the resilience of the smallholder farmers is not achieved.

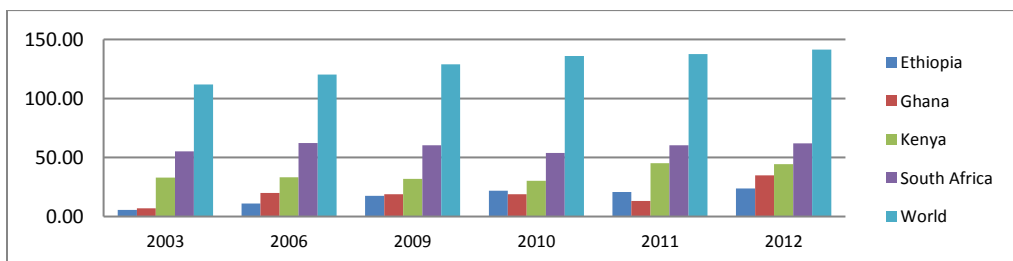


Figure 11. Comparison of fertilizer consumption

Source: FAO (2014)

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The input subsidy since 2006 shows a decreasing trend (from 170 million to 90 million Birr in 2012, although it reached a maximum of 240 million Birr in 2011) (FAO, 2014). There should be clear distinctions between investment and spending on inputs. In low- and middle-income countries, the majority of private domestic investors are considered to be farmers and they are by far the largest source of investment in agriculture. But the farmers mostly are not investing on activities that result in the accumulation of capital (which may be physical, human, intellectual, natural, social or financial) that yields a stream of returns over time (Sarha et al., 2012). The same is true in Ethiopia, where farmers are investing on agricultural inputs. Therefore, their spending is considered to be expenditure.

Investment in agricultural education

Universities are part of the NARS and are engaged in conducting agricultural research to generate technologies and, as a result they, exercise pre-extension activities within their vicinity (Belay, 2015) through their community services and projects they are running. Over the last 15 years, the government of Ethiopia has made efforts to improve the agricultural system in supporting the nation's efforts to improve food security and reduce poverty through its ADLI and GTPs. Ethiopia's capacity to leverage science and technology for innovation in the agricultural sector remains weak (David et al., 2012).

The amount of budget allocated to higher education by the government is increasing. A number of universities are being built (this time the number of universities reached 32), more than 70 ATVET are functioning throughout the country. The efforts to improve the contribution of agricultural education towards poverty reduction are appreciable. As can be seen in table 1, the total budget allocated/expended towards education is increasing and, at the same time, greater than that of other sectors. The number of graduates from higher institutions is also increasing alarmingly, but their quality is been brought to question.

Table 4. Summary general government finance performance (cumulative) in million birr

<i>Year</i>	<i>Agriculture</i>	<i>Education</i>	<i>Health</i>
2006 - 2007	1,703	4,896	1,009
2007- 2008	2,329	6,621	1,484
2008 - 2009	2,714	8,009	1,737
2009 - 2010	2,184	9,820	2,162
2010 - 2011	2,845	12,395	2,916
2011 - 2012	3,415	16,246	3,899
2012 - 2013(Budget)	4,056	20,879	5,254

Source: Yihenew et al. (2013)

Investment in food security programmes

There are four food security programmes in Ethiopia: Productive Safety Net Program (PSNP), Household Asset Building Program (HABP), Resettlement Program and CCI (Complementary Community Investment). Among the main expenditures to agriculture, payments to consumers through the food security programmes constitute the largest share (23%) of the total, considered to be the highest in Africa (FAO, 2014). In 2008, the total public expenditure escalated due to the maximum budget for the PSNP. The primary aim of the food security programmes was designed to help chronically food insecure households reach a level of food security necessary for an active and healthy life (MoARD, 2009). Through the efforts of the food security programmes, modest changes were put in place. Early warning systems improved; emergency operations saved millions of lives (the condition in 2016 is an indicator—where more than 12 million people are hit by drought and subject to food deficit, but in which there was reduction in the number of lives lost, compared to previous times).

NSA investment trends in Ethiopia

Non-profit and for-profit private companies, although involved in some collaboration effort with EIAR and the universities, have minimal involvement in agricultural R&D in Ethiopia. Therefore, the role of the non-profit and private sectors is excluded in the analyses. Ethiopia has experienced double digit economic growth per year since 2004. This growth came from different dimensions, including expansion of the services and agricultural modernization, the development of new export sectors mainly agricultural commodities, strong global commodity demand and large scale investments. As MoFED (2013) released in its report, 2.5 million people have been lifted out of poverty starting from 2005, and the share of the population below the poverty line has fallen from 38.7 percent in 2004/05 to 29.6 percent in 2010/11.

In all developmental sectors, the Ethiopian economy has been growing by 10.9% on the average in the past decade and its GDP was \$47 billion by the end of 2012/13. Agriculture remained a dominant sector in the Ethiopian economy, and is an important source of its growth, contributing 45% of the GDP. The average rate of growth has been around 7% per year for the past 15 years. This growth came due to increased area under cultivation, advances in agricultural R&D, improvement in agricultural extension and a large public agricultural investment (CSA, 2015).

The federal public spending on agriculture is between 13 to 17% of government expenditure (equivalent to over five per cent of the GDP) in recent years, which is in excess of the CAADP 10% target level. About 30 and 10% of agricultural investments come from grants and concessional loans, respectively, while the remaining 60% is

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funded by the government. More than half of this expenditure supports chronically food insecure households under the DRMFS Programme (ReSAKSS, 2014).

Agricultural research and development (R&D) investments are a crucial determinant of agricultural productivity through the introduction of improved agro-ecologically suited agricultural technologies (Alston et al., 2000; Evenson, 2003; IAC, 2004). To boost agricultural productivity, the government of Ethiopia has given great attention to research and development activities, mainly on agricultural innovations (crop, livestock, NRM, agricultural mechanization etc.), access to agricultural inputs, output value-chain system, agricultural water management, and demand-driven agricultural technology tailored to specific agro-ecologies and socio-economic conditions of the rural community.

Among all the agricultural activities listed above, agricultural research is taken as a major mechanism for growth in agriculture. The National Agricultural Research Institutes (NARIs) have been playing a great role in alleviating some of the agricultural problems in Ethiopia. Integrated agricultural research and development activities started with the establishment of the Institute of Agricultural Research in 1966 (Tsedeke et al., 2004). The agricultural innovations offered by research give agricultural research a central role in changing the livelihood of the people, and supporting the Agricultural-Led Industrial Development (ALID) plan of Ethiopia. But agricultural research in Ethiopia is still quite young.

In Ethiopia, agricultural research is conducted mainly by public research institutes, with the objectives to generate, develop, and adopt agricultural technological innovations that focus on overall agricultural development and the needs of farming community through all its research institutes and collaborators. The Ethiopian Agricultural Research Organization (EARO), now the Ethiopian Institute of Agricultural Research (EIAR), was established in 1997, and merged all the existing regional agricultural research institutes and research centres. In addition to EIAR, all public higher education institutes conduct agricultural research relevant to their local conditions in Ethiopia. A few private companies conduct some agricultural research in Ethiopia, but their combined efforts are reportedly small (Demel, 2002).

Trends in investment on agricultural research and development

Agricultural research in Ethiopia is still largely financed by government contributions. The total financial expenditure allocated for public agricultural research in Ethiopia is about US\$ 8 million per year. Eighty percent of expenditure for public agricultural research institutes is funded from the government budget, while 20% come from donors and others (WANA NARS Studies, 1999).

As shown in figure 2, investment in public agricultural R&D in Ethiopia increased significantly after 2000, peaking in 2002 as a result of government and donor support. In 2008 and 2009, agricultural research spending had dropped. This spending did not bring a significant change on agricultural productivity, since it was affected by political unrest, recurrent drought and institutional instability. Even today, the contribution of non-governmental and private institutions towards agricultural research and development are very limited, and a majority of agricultural researches are still being conducted by the public sector. About two-thirds of total agricultural spending is used by the Ethiopian Institute of Agricultural Research (EIAR). The remaining budget is channelled to regional agricultural research institutes, agricultural research centres and higher education institutes. The data in figure 2 show the total investment in agricultural research in Ethiopia, organized from data collected from different sources, such as EIAR, ASTI website and World Bank database.

Table 5. Total public agricultural research and development spending in Ethiopia

Period	Spending, total (million constant 2011 US \$ dollars)	Spending, total (million constant 2011 PPP dollars)	Spending, total (as a share of AgGDP, %)
1991-1995	76.6	263.0	1.5
1996-2000	84.4	291.4	1.6
2001-2005	141.7	486.8	2.6
2006-2010	121.2	416.3	1.3

Source: ASTI data base 2015 and own computations

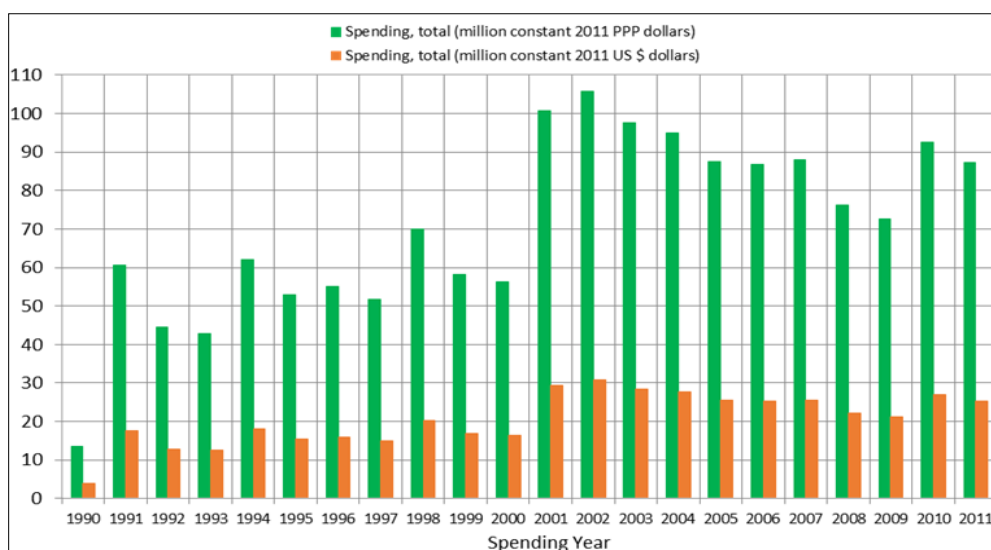


Figure 12. Total investment in agricultural research in Ethiopia

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Sources: Compiled by authors from Ethiopia's Aid Management Platform (AMP), ASTI survey data (IFPRI –ISNAR–ASARECA 2001–02).

In Ethiopia, donor funding is insignificant (less than 20 percent). From the time-series data, there were sharp drops in 2008 and 2011 in their shares of donor funding. In general circumstances, it peaked at US\$ 228 million in 2013, attributed to maximum funding of US\$ 191.4 million from the International Development Association (IDA) and multilateral agencies equally in support of agricultural research where there was no support in the other four consecutive years. Total ODA funding in support of agricultural research declined precipitously during 2014, reaching US\$ 40 million in 2002 (in 2013 USD constant prices).

Table 6. Total ODA for Ethiopian agricultural research through all channels (2013 USD millions constant prices)

<i>Yea</i>		<i>Flow Type</i>		<i>Yea</i>		<i>Flow Type</i>	
<i>r</i>	<i>Commitmen</i>	<i>Disbursemen</i>	<i>Tota</i>	<i>r</i>	<i>Commitmen</i>	<i>Disbursemen</i>	<i>Total</i>
2000	3.07	0	3.07	2008	1.15	4.76	5.91
2001	6.52	0	6.52	2009	59.37	19.09	78.45
2002	3.94	10.03	13.97	2010	13.07	36.12	49.19
2003	4.51	8.67	13.18	2011	3.93	11.99	15.92
2004	2.53	7.39	9.92	2012	17.94	15.44	33.37
2005	1.05	5.17	6.21	2013	197.49	30.80	228.29
2006	52.38	6.47	58.85	2014	6.22	34.25	40.47
2007	12.11	24.67	36.78				

Sources: Compiled by authors from Development Assistance Group (DAG), ASTI survey data (IFPRI –ISNAR–ASARECA 2001–02)

As shown in table 3, the overall development assistance (ODA) to Ethiopia was USD 40 million in 2014. In average terms, on 7% went to agricultural R&D. Based on various documents obtained from DAG, OCED database, ASTI-IFPRI and the National bank of Ethiopia, the largest providers of development assistance to Ethiopia are the World Bank, the United States, the United Kingdom, the African Development Bank and the Global Fund. National and regional research institutes receive very

limited funding through other sources, only about \$1 million per year (1% of total funding) was generated internally. Their output sales and revenues raised are passed on to MoFED. The core datasets captured to analyse the total ODA spending to Ethiopia on agricultural research and development channelled through commitment and net disbursement from 2000 to 2014 are indicated in figure 3.

Research by public agencies in Ethiopia has been seriously affected as a result of large discrepancies between budget commitments and actual disbursements of funds, along with significant delays in the disbursement of funds. During 2013, for example, only 15% of the donor released budget was disbursed. Total public spending as a percentage of agricultural output (AgGDP) is a common indicator of agricultural research spending used for comparison purpose. In 2002, for every \$100 of agricultural output, only 0.60% was invested in agricultural R&D, which is the maximum spending on agricultural R&D for the last two decades (figure 4). Despite the aforementioned increase in 2002 and 2003, the ratio had been lowered, reaching a minimum spending of 0.20% in 2011. In 2011, for every \$100 of agricultural output, \$0.20 was invested in agricultural R&D, which is very low compared with what obtains in other countries such as Kenya and Tanzania, whose ratios that year were \$0.91 and \$0.33, respectively (ASTI/IFPRI/CGIAR, 2013). Therefore, overall investment level in Ethiopia is still well below the levels required to sustain agricultural research and development needs.

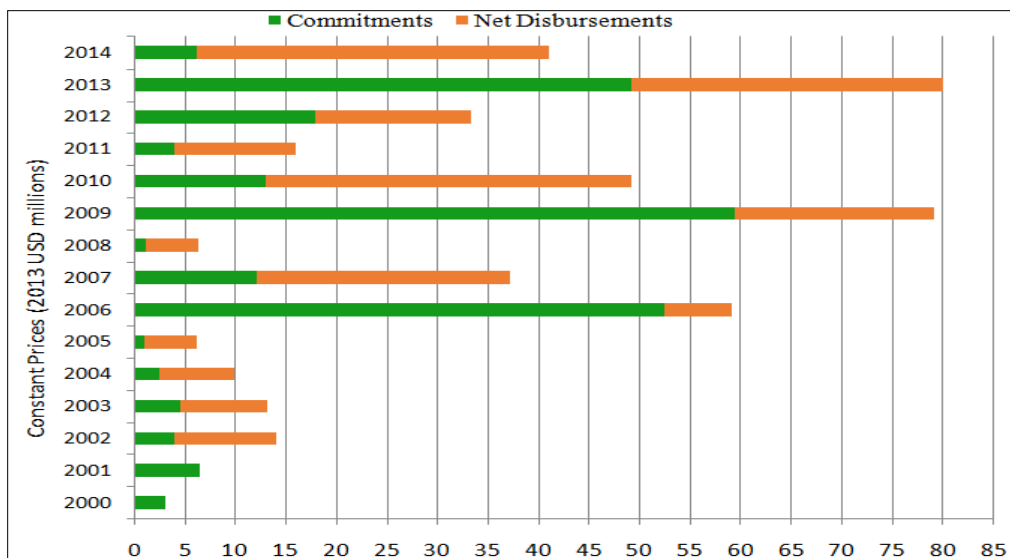


Figure 13. ODA for agricultural research

Source: Compiled by authors from ASTI and OECD (2015) datasets

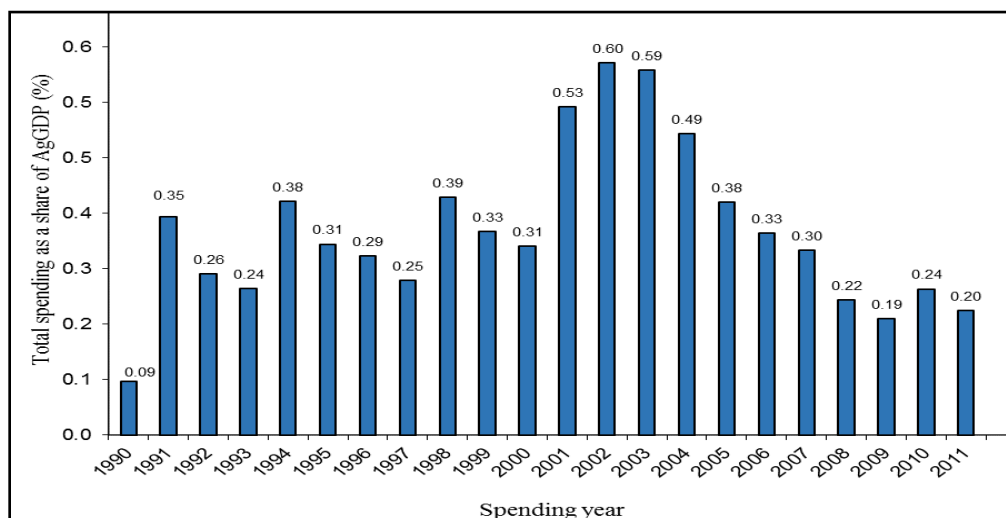


Figure 14. Intensity of agricultural research spending 1990–2011

Sources: Compiled from ASTI database and OECD 2015

The CGIAR and other international research efforts

Until 1985, NGOs were focusing on relief and humanitarian services in response to the famines in 1977 and 1985. After 1991, the number of NGOs has increased and, most recently, the federal government ratified the first comprehensive law governing the registration and regulation of NGOs.

In Ethiopia, some international agricultural research organizations have now being investing in agricultural research and development by its own and in collaboration with NARIs, higher education institutions, and agriculture and rural development offices operating at all levels. Major collaborative projects are implemented jointly with the Centres of Consultative Group on International Agricultural Research (CGIAR), such as the International Maize and Wheat Improvement Centre (CIMMYT), International Livestock Research Institute (ILRI), International Centre for Agricultural Research in the Dry Areas (ICARDA), International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), International Institute of Tropical Agriculture (IITA), International Centre for Tropical Agriculture (CIAT), and Bioversity International (BI) (Bechere, 2007; Tsedeke et al., 2004). For instance, CIMMYT awarded EIAR about 18 grants (70.328 million birr) between 2008 and 2014 (Bezabeh, 2015). Despite the annual budget of CGIAR centres, about 2% of donor funding flows via NGOs and the civil society organizations for agricultural research and development, as shown in figure 5.

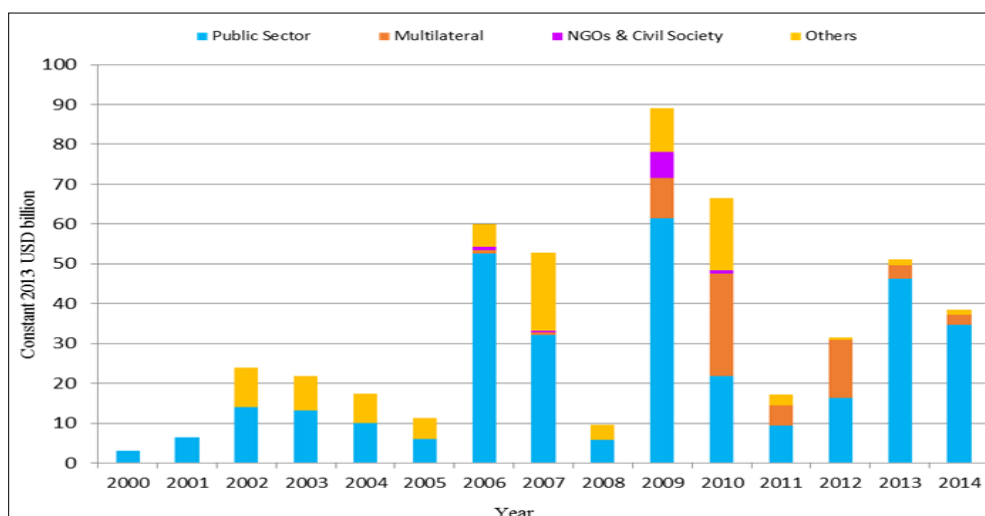


Figure 15. Allocation of assistance to agricultural research via different channels

Sources: Compiled from ASTI database and OECD 2015

In addition, NARIs have collaborative projects with other international agencies such as the International Fertilizer Development Centre (IFDC), International Fund for Agricultural Development (IFAD), International Food Policy Research Institute (IFPRI), the International Centre for Insect Physiology and Ecology (ICIPE), and a number of universities in countries like Germany, the Netherlands, and the United States (EIAR, 2012).

Private agricultural R&D

Private-sector investments in agricultural research and development in Ethiopia is extremely limited and mainly focus on the provision of imported agricultural input technologies and services for agricultural production. Private sectors have minimal involvement in agricultural research by spending less than half of 1% of total agricultural research expenditure. Most of the private sectors contract EIAR and other research institutions to conduct research on specific issues on their behalf (Beintema, et al., 2003).

Opportunities for NSA towards agricultural investment

There are a number of opportunities to invest on agricultural innovation in Ethiopia. The following is a list of opportunities for non-state actors:

- ☞ Political and macro-economic stability
- ☞ Clear policies designed
- ☞ Competitive, hospitable and trainable labour
- ☞ Vast and fertile land

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- ☞ Institutions for agricultural sector established at all levels
- ☞ Abundant and diversified natural resources and diverse climate

Challenges of NSA agricultural investment

1. *Insufficient physical and financial resources:* Public agricultural research expenditure grew by 6% per year on the average, at an apparently steady pace during the past three decades, while the number of public agricultural researchers increased by more than 10% per year (Demel, 2002; Beintema et al., 2003).
2. *Retention of qualified staff:* The existing salary and incentive schemes in agricultural research institutes cannot cover the overall increased cost of living expenses of the researchers. This is one of the main reasons for staff turnover.
3. *Quality of agricultural staff:* On the average, more than 59% of the agricultural researchers have postgraduate degree training, while less than 10% have doctorate degrees. (Pardey et al., 1997; Beintema, 2003).
4. *Disaster Risk:* Recurring drought and famines

METHODOLOGY

Agricultural productivity improvements are important for broader development objectives such as poverty reduction and food security. It is essential to use the appropriate indicator and measure of agricultural productivity: partial factor or total factor productivity. Conceptually, productivity is simply a measure of output to input. However, because it embodies many different components, changes in productivity can catalyse a wide range of direct and indirect effects on the pathways to achieving different development objectives of the country. For example, output per worker or labour productivity, as a partial measure of productivity, may be a better measure to identify linkages to non-agricultural growth, since it encapsulates the additional ways through which farm households earn income (Mellor, 1999). Regarding the total measure of productivity, Fan et al. (2000) for example, found that investments in roads, agricultural research and development, and education had the largest impact on raising total factor productivity, in turn substantially reducing poverty via reduced prices and increased wages, albeit at the cost of increased landlessness.

In understanding the different components and definitions of total factor productivity (TFP), there are different types of estimation techniques for sectoral TFP. The study, however, uses the growth accounting approach in order to reap the benefits derived from taking into account technological change, efficiency change and scale effect dimension of TFP. Thus, the study uses the following growth accounting model to estimate the TFP of agriculture.

$$g_Y = g_{TPPA} + \beta_1 g_L + \beta_2 g_K + \beta_3 g_{Ld} \tag{1}$$

Rearranging equation (1) to get the growth rate of sectoral TFP equation leads to:

$$g_{TFPA} = g_Y + \beta_1 g_L + \beta_2 g_K + \beta_3 g_{Ld} \tag{2}$$

The data for this study was collected from key informants and secondary sources, including policy and strategy documents, published and unpublished literature, programme reviews and government and nongovernmental organizations reports. The study employed qualitative and quantitative approaches to understand the impact of investment on agricultural innovation investment on the total factor productivity of the country. The estimation results of equation (2) using a 35 year-time series data, as shown in table 4.

Table 7. Contributions of factor accumulations and technological change on agricultural growth

Period	Agriculture value added (% growth)	Contribution to growth of agriculture (%)				Efficiency
		Land	Labour	Capital	TFP	
1981-1985	-1.10	-4.16	-17.57	28.69	5.86	0.767969
1986-1990	3.86	-8.69	12.93	-0.06	-0.32	0.024133
1991-1995	13.75	-2.47	3.51	12.29	0.42	1.001193
1996-2000	3.77	-1.94	1.80	1.33	2.58	0.999813
2001-2005	7.36	1.32	1.85	6.36	-2.17	1.000034
2006-2010	29.47	-7.46	23.98	8.90	4.04	0.999998
2011-2014	19.58	2.47	31.25	0.05	-14.18	0.999949
1981-2014	9.09	-0.16	4.95	9.54	-5.24	1.000000

Source: World development indicator, World Bank data base 2015 and own computations

Since relatively sufficient time series data (1981-2014) on most of the variables under consideration are obtained in current values, the values of most variables are expressed in terms of the current/market values. For example, the agriculture value added, values of land, labour and capital are expressed in terms of the market prices. Moreover, in

this study, missed values in a given variable are replaced by their estimated values. Otherwise, the STATA software will cancel that variable in general and our observation will become too small to estimate the parameters. As shown in table 4, the annual average values of the agricultural sector productivity and growth parameters are estimated every five years. Data on capital (gross fixed capital formation) are not available for the first five years. The paper therefore uses estimated value of capital in this case. This may be the reason why the productivity of capital and TFP in this period are unexpectedly higher in this period, as compared to the other study periods.

Different literature on productivity have mentioned that there are two main sources of growth of an economy (being agricultural, industrial or service sector). These are factor accumulations and technological progress. The former usually has only a level effect on the growth of an economy. Unless technological progress (which is reflected by an improvement in TFP) is achieved, sustainable and rapid growth is unthinkable. Using the estimates of the agricultural sector TFP growth obtained from the growth accounting method, the study specifies the determinants of sectoral TFP. The broad source of the TFP growth is innovation (knowledge creation) in a domestic economy and technology transfer (absorption and transmission of knowledge) from abroad.

$$g_{TFPA} = f \left(\begin{array}{l} R \& D, imported \text{ capital good}, openness, \\ serviceliberalization, humancapital, inf rastructure, inf lation \end{array} \right)$$

Following the growth accounting approach that gives TFP in terms of growth rate, this study considers the explanatory variables in terms of growth rates so as to be uniform with TFP. The VARX model that is used in identifying determinants of TFP of agriculture is presented as follows:

$$g_{TFPA} = f(g_{RD}, g_{ICG}, g_{RNW}, g_{PuPS}, opp, tsli, inf) \quad (3)$$

Where g_{TFPA} = TFP growth rate for agriculture; g_{RD} = growth rate of government expenditure for R&D; g_{ICG} = growth rate of imported capital goods; g_{RNW} = growth rate of road networks in kilometres; g_{PuPS} = growth rate of pupils in primary school; opp = openness of the economy; $tsli$ = trade service liberalization index; inf = inflation. The estimates of equation (3) for data of the same periods are presented in table 5.

Table 8: Determinants of TFP of agriculture

<i>Determinants</i>	<i>Coefficients</i>		
	<i>1981-1999</i>	<i>2000-2014</i>	<i>1981-2014</i>
R & D	0.1030486	-.0142686	-.1570026
Education	0.1843353	.7616234	.2878051
Inflation	0.0189223	.377374	.243478
Road network	0.352617	-.523046	-.2937638
Openness of the economy	-1.313668**	.2651807	-.4611273
Trade service liberalization (Domestic credit to private sector)	1.370475***	1.271996	.7717983
Constants	0.9674659	-44.20049	-2.315198

Notes: *, ** and *** refers to significant at 10 %, 5% and 1 % respectively.

RESULTS

The agricultural sector of Ethiopia has grown for more than a decade, with an annual average of more than 9%. The source of this growth is mainly due to factor accumulation (particularly labour and capital), as most of the parameters of these factors are positive. The technological advancement has also started to play an important role in the agricultural sector, mainly in 1991-2000 and in 2006-2010. The agricultural sector performs its activities efficiently (as its value is almost closer to one), with the exception of the first decade, as shown in table 4. Land has a positive contribution to the growth of the economy during 2001-2005 and 2011-2014, while the TFP is negative in these periods. This may be due to the fact that during the last GTP I period, the government had due emphasis for the manufacturing sector, by considering it as a main driver of the economy. Hence, the government may shift a significant portion of its resources, incentives and technical supports, including R&D activities towards the manufacturing sector in general.

As depicted in table 5, investment in innovation does not have a significant effect on improving the productivity of agricultural sector in Ethiopia in general between 1981-1999, 2000-2014, and 1981-2014. The major source of TFP growth of agriculture observed between 1981 and 1999 is the availability of credit to the private sector (as a proxy measure of domestic trade liberalization), although the openness of the economy affected it negatively, as this may be due to the fact that the global competitions in agricultural products may discourage our smallholder farmers as they could not compete with the products entering the country from the western world. In this analysis, the data for R & D includes only the government and donor organizations and expenditures for development assistance and technical coordination. If appropriate disaggregated data on different sectors (such as agriculture, industry and service sectors) were available, with respect to all the important variables of the analysis, the

results of the estimation could be further improved so as to determine clearly how much innovation affects the agricultural productivity, and thereby reduce the food insecurity and poverty of the Ethiopian society.

Conclusion and Recommendations

Investment on agricultural innovation in Ethiopia was found to be very limited. As the progress of agricultural innovation towards food security is at its infant stage, its contribution in reducing poverty and achieving food security is limited. The research findings indicate that investment on agricultural innovation does not have a significant effect on improving the productivity of the agricultural sector in the country. The country has achieved the CAADP minimum financial allocation to the agricultural sector. The commitment of the government towards livelihood security is also very encouraging. Ethiopia is on track to achieving the CAADP plan in growth, and the reduction of poverty, hunger, and food and nutrition insecurity. But the allocation of at least 10% every year to agricultural sector will not be enough to achieve the intended objectives. Of the total budget allocated to the agricultural sector in the country, a huge amount was for food security programmes for consumption. The research and development sub-sector are not receiving enough amount to bring about changes.

Agricultural production and productivity has been growing in the country. The growth is attributed to the relatively increased application of input and expansion of arable land. The contribution of investment on innovation, both by the government and non-state actors is very limited, and mainly focuses on the provision of imported agricultural input. The sectors have minimal involvement in agricultural research by spending less than half of 1% of the total agricultural research expenditure. The government of Ethiopia has invested a lot of money to establish universities and research centres in different corners of the country. These institutions are not properly linked with the extension system. The establishment of institutions can be taken as part of the success, but the system establishment and investment towards innovation should have to be further scrutinized in achieving food security. Based on the findings and conclusion, the study recommends the following:

1. As Ethiopia is dependent on rainfed agriculture, the impact from extreme climatic conditions hamper agricultural productivity and, hence, hunger and food insecurity. To reduce the impact of the disaster risks, the investment on agricultural innovation should have to be revised and implemented accordingly.
2. The agricultural investment in Ethiopia is mostly invested for consumption through food security programmes. Though life savings is of paramount importance, the emergency management intervention will not bring the intended growth and transformation. Therefore, the share of investment on

- agricultural innovation from the public, private and NGOs should have to be increased.
3. The low adoption and application of agricultural inputs can be in part explained by lack of access to credit, which is a determining factor in fertilizer use as well as seed purchase. Therefore, improving Ethiopia's input-credit system with crop insurance will bring changes towards the efforts in achieving food security.
 4. The 2016 drought can be taken as a case in point to show the dependency on rainfed agriculture. The agricultural growth that the country has been achieving will not be able to make the population food secure. Therefore, the intervention of different actors is inevitable to build the capacity of the population and sustain the growth in agriculture.
 5. Access to credit is one of the bottlenecks for farmers to use improved agricultural inputs, as the price of agricultural inputs is increasing. On top of this, the agricultural input supply is undertaken by the government, with the exception of some private seed suppliers.
 6. Agricultural growth in the country is attributed mainly due to factor accumulation (particularly labour and capital). Agriculture remains low input, low-value and subsistence-oriented, and is vulnerable to frequent climatic shocks. Exploring innovations that could create market-oriented, agro-ecologically system, with a viable extension system, will improve the food security situation of the population. Therefore, investment on such an important system in the research and development arena is advisable.

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