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## AGRICULTURAL DEVELOPMENT IN DROUGHT-PRONE AREAS OF ETHIOPIA:

Interventions, Challenges and  
Good Practice

September 2018

*AKLDP Assessment Report  
Kidane Giorgis, Agajie Tesfaye and  
Getnet Assefa*

AKLDP ETHIOPIA



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# ACRONYMS

<b>ADPLAC</b>	Agricultural Development Partners Linkage Advisory Council
<b>AI</b>	Artificial Insemination
<b>AKLDP</b>	Agriculture Knowledge, Learning, Documentation and Policy Project
<b>ATA</b>	Agricultural Transformation Agency
<b>CGIAR</b>	Consultative Group on International Agricultural Research
<b>DA</b>	Development Agents
<b>EIAR</b>	Ethiopian Institute of Agricultural Research
<b>FAO</b>	Food and Agriculture Organization of the United Nations
<b>FGD</b>	Focus Group Discussion
<b>FHH</b>	Female Household Heads
<b>FTC</b>	Farmer Training Centers
<b>HAB</b>	Household Asset Building
<b>ICRISAT</b>	International Crops Research Institute in Semi-arid and Arid Tropics
<b>IFPRI</b>	International Food Policy Research Institute
<b>IPM</b>	Integrated Pest Management
<b>KII</b>	Key Informant Interviews
<b>LA</b>	Livestock Agencies
<b>MFI</b>	Micro Finance Institutions
<b>MoALR</b>	Ministry of Agriculture and Livestock Resources
<b>NARS</b>	National Agricultural Research System
<b>PPP</b>	Public Private Partnership
<b>PSNP</b>	Productive Safety Net Program
<b>UNCCD</b>	United Nations Convention to Combat Desertification
<b>WUA</b>	Water Users Association

# EXECUTIVE SUMMARY

## Introduction

About 75% percent of Ethiopia's landmass is categorized as dryland, experiencing moisture stress during most months of the year, and having between 45 and 120 days of growing season per year (Kidane Georgis et al, 2010). These areas are home to about one-third of the country's population, as well as a comparable proportion of livestock. The drylands are becoming a center of attention in Ethiopia for various reasons, including their resource degradation caused by continuous increases in human and livestock populations aggravated by climate change and variability. Despite these problems, several dryland areas in Ethiopia have a tremendous resource base covering crops, animals, vegetation, water, fertile soils and forest resources.

Questions are being raised as to why the drylands are becoming the center of food and feed insecurity, malnutrition, poverty and famine in Ethiopia. It is argued that this is because policy makers, planners, researchers and development experts marginalize these areas in research and development due to misconceptions that drylands have less potential for development (Kidane Georgis, 2015). The Ministry of Agriculture and Livestock Resources has put addressing these challenges as its high and urgent priority. With this in mind, the overall aim of this study was to make a quick assessment and analytical study on the drylands, and specifically in drought-prone crop-livestock mixed farming systems, to understand the underlying factors hindering development in these geographical domains and to come up with possible recommendations.

## Study Approaches and Methods

**Scope of the study and location:** - The study's scope was in dryland areas, ranging from highlands to lowlands moisture stressed areas, in the major agro-ecologies of the drought prone mixed farming areas of selected representative woredas in Amhara (Kobo /Raya Kobo), Tigray (Wukro /Kilte Awlalo) and Oromia (Zeway/Batu Zeway Dugda) regions. The

study assessed the agricultural, livestock and natural resources management technologies introduced, their status and performance, good practices for development of drylands, challenges and opportunities, and related socioeconomic issues.

**Target groups of the study and data sources:** - The study mainly targeted primary data sources including smallholder farmers (male headed and female headed households and youths), non-governmental organizations, private enterprises, and government organizations (regional, zonal and woreda bureaus of agriculture, livestock agencies, kebele level development agents, research institutions, etc.). Other information related to the purpose of the study was collected from secondary sources.

**Data collection tools, techniques and reporting:** - Three standard data collection techniques and approaches were employed in this study including desk reviews, participatory approaches and case analysis. Participatory tools used at the qualitative stage included key-informant interviews (KIIs) and focus group discussions (FGDs). A total of 44 targeted KII, 26 FGD, and 16 case analyses were conducted. Direct observations were made of farming practices both in rain-fed and irrigation-based dryland areas, and innovations and exemplary achievements of model farmers were also verified through observations. The information generated from the study was analyzed and the draft report subjected to a small group discussion with selected senior researchers in the field of the study. This final report was then revised according to their inputs.

## Findings of the Study

Dryland agro-ecological areas, especially those considered in the study, are largely characterized by moisture stress as well as inadequate infrastructure (roads, telecommunications, potable water supplies, human and livestock health services, etc.). There is also often limited accessibility to large market centers and inadequate access to agricultural and non-agricultural technologies. Consequently, the livelihoods of most rain-fed dryland farmers are more fragile than those



in irrigation-based drylands farming. The dryland agriculture of Ethiopia tends to have two distinct features: In areas where irrigation or supplementary irrigation is practiced, farmers focus on crops and keep cattle mainly for traction, but sometimes fattening animals and producing dairy. While in dryland areas which depend on rain-fed agriculture, livestock is the major means of livelihood. Crops usually are not reliable enough, and almost all households keep goats and sheep, with better off farmers able to keep larger herds of cattle. In these areas livestock are managed extensively with no or very low technical input.

## Interventions

**Crop production:** - In crop production, improved crop varieties of cereals (sorghum, maize, tef and wheat), legumes (chickpea, mung beans), vegetables (tomato, onion and pepper) and fruits (mango and banana) have been introduced. These major crops are grown both under rain-fed and irrigation/ supplementary irrigation. The numbers of improved varieties introduced are very few in relation to the number of potential technologies generated and targeted for dryland areas. Similarly, improved technologies of agronomic practices, fertilizer use, plant protection, mechanization, storage and post-harvest processing have been introduced and demonstrated in the studied areas. Some of these technologies are successful, but their use and expansion is very limited for various reasons.

**Livestock production:** - Livestock is an important component of the production system of drylands. In the areas studied it supports crop production and also in some cases is the sole means of livelihood. There have been various improved livestock technologies introduced and demonstrated in the study areas, including: breed improvement of ruminant animals (cattle, sheep and goats); feed technologies (pasture management, crop residues, cultivated forage crops, and agro-industrial by-products); animal health; improved dual purpose strains of poultry; apiculture; fattening; processing and marketing. Compared to the others, poultry, apiculture, fattening, and improved dairy were the most successful interventions, with the wider expansion of the others constrained by several factors.

**Natural resources management:** Degradation of natural resources is the greatest constraint to sustainable agricultural development in almost all parts of the drought prone areas. In this study, it was observed that farmers are attempting to conserve any available water through construction of dams, digging boreholes, and rainwater harvesting for irrigation, livestock and other uses. Producers have also tried efficient water utilization using conservation agriculture practices and irrigation techniques to minimize wastage. In rain-fed systems farmers also use tie-ridgers, mulching and

water conservation structures for the efficient use of available moisture. Most water sources that are used for irrigation and livestock drinking in the study areas visited were communal, with utilization rules and regulations that require improving for more efficient and fair use of this precious resource. In the study areas it was possible to see soil conservation strategies including terracing, construction of gabions and area enclosures, but the extent of expansion of these technologies is still limited.

## Challenges

**Agricultural extension services in drylands:** - In Ethiopia the same extension approach is being practiced across all agro-ecologies, farming systems and livelihood strategies. There is no specific extension approach and compatible system designed for drylands, which are characterized by limited access to infrastructure and public service centers, a challenging climate, household food insecurity, frequent drought occurrence, moisture stress and other problems. A significant number of agricultural development staff deployed to drylands are not graduates specialized in dryland agriculture, and there is almost no motivation among agriculture staff and development agents (DA) who face the challenging conditions of the drylands. Resource allocation does not consider the specific problems in drylands and it was generally observed that the extension services were weak and inefficient in the study areas.

**Adoption of technologies:** - In dryland areas where there is access to irrigation, the adoption of improved technologies, such as improved varieties of cereals, vegetables and fruits, has progressed well. On the other hand, agricultural technology adoption and use is much lower in rain-fed dryland areas— mainly due to frequent droughts and the erratic nature of rainfall distribution, which often terminates early at the time of flowering and grain filling. Even the short maturing improved varieties of crops require supplementary moisture late in the growing season, and therefore it was evident that supplementary irrigation is required in the late growing season to allow such technology adoption and improve livelihoods of dryland households. Adoption of technologies like poultry, apiculture and soil and water conservation in rain-fed areas is very encouraging, however.

**Factors affecting technology adoption:** - Despite the efforts made, success in the various areas of agricultural interventions and overall improvement of livelihoods in the drylands was found to be very limited. The major gaps and challenges hindering development are climate variability accompanied by the limited economic capacity of the community

to invest in improved agriculture. This results in restricted use of inputs and leads to a heavy reliance on continuous emergency assistance, which has brought about dependency syndrome. At the same time, the introduced technologies are also said to be inadequate, fragmented, without proper packaging, and at times initiated without a needs assessment or prior knowledge of their appropriateness to the targeted localities, resulting in their poor adoption. The low level of awareness and skills of beneficiaries and extension workers on introduced technologies also contributes to failure in implementation. The scaling up of the good practices is also constrained by the lack of timely supply of inputs, like improved seeds, the ineffective extension system and overall poor marketing linkages.

## Suggested good practice intervention options and the way forward

Based on the observations and critical analysis of this study, the major strategic intervention options to address dryland challenges and improve the livelihoods of fragile households on a sustainable basis are as follows:

- Utilize available potential / resources and create more access to irrigation / water
- Develop stress tolerant (to drought, heat, pest and diseases etc.), and productive, crop varieties
- Utilize crop physiology technologies and simulation models as a tool for yield improvement in the drylands and the promotion of potential crops like grain legumes and oil crops
- Strengthen wider use of improved livestock technologies, like dual purpose poultry and fattening
- Design dryland friendly extension approaches, as well as infrastructure facilities and public services
- Strengthen watershed-based dryland farming
- Introduce, promote and disseminate technologies as packages as much as possible
- Focus on long term interventions rather than short term benefits
- Establish a system of reliable information exchange
- Establish a sustainable system of recognition and motivation
- Introduce and strengthen cluster-based and multi-stakeholder innovation platform approaches for interventions and focus on changing attitudes of dryland households
- Strengthen institutional arrangements and empower agricultural offices in the drylands
- Strengthen research, education, extension institutions and networks in the drylands.

# 1. BACKGROUND

## 1.1 The purpose of the study

In the dryland areas of Ethiopia climate change and associated drought problems are leading to poor harvests of both food and animal feed. Nutritional insecurity, poverty and poor livelihood situations are becoming the norm in these areas. Across the wide range of Ethiopia's drylands, the areas that are prone to drought include the highland and mid altitude areas, where the farming systems are mixed and both crop and livestock production is important. The agro-ecology of these areas is fragile and the environment increasingly unstable. Social problems in the drylands include limited capacity for investment, limited infrastructure, greater risks in agricultural production and severe poverty. Loss of access to grazing land has also resulted in overgrazing, which is one of major causes of land and natural resource degradation. Modest research and development efforts have been made to address the major challenges of drylands, but no significant change has been realized and the problems are persisting.

The drylands are becoming a focus of attention for various reasons, including their resource degradation caused by continuous increases in human and livestock populations, which is aggravated by climate change and climatic variability. Although Ethiopia's drylands have a tremendous resource base—including crops, livestock, vegetation, water, fertile soils and forests resources—questions are now being raised that if the drylands have such resources why are they becoming the center of food and feed insecurity, malnutrition, poverty and famine in Ethiopia? It is argued that this is because these areas have long been marginalized in research and development by policy makers, planners, researchers and development workers due to the misconception that they have less potential for development (Kidane Georgis, 2015).

In recent years research and development interventions have begun to address the major challenges of dryland areas; for instance, the Ministry of Agriculture and Livestock Resources (MoALR) has put the drylands high on its development agenda. Unfortunately however, people are still by and large food insufficient and dependent on direct and indirect aid. Assessing the research and development interventions initiated and implemented by government, NGOs and the private

sector in these dryland areas could provide useful information on the successes, failures, challenges and underlying causes of their persistent vulnerability to drought.

As part of its program of support in documenting evidence-based good practice, the Agriculture Knowledge, Learning, Documentation and Policy Project (AKLDP), commissioned a consultant team to undertake a rapid study to assess the status of agricultural development and related interventions in the drought-prone mixed farming dryland areas of the country. The overall aim of the study was to make a quick assessment and undertake an analytical study on the drylands to understand the underlying factors hindering their growth and development, and come up with possible recommendations.

### The following specific objectives were identified:

1. Review and document agriculture, livestock, natural resource management and related development **interventions**, and accompanying changes in people's livelihoods and bio-physical environment, of the drought-prone mixed farming systems;
2. Identify the socio-economic and bio-physical gaps and **challenges** hindering agriculture and livestock development in the drought-prone areas; and
3. Make an inventory of successful **good practice**, identify development and technology needs in the drought-prone areas, and suggest future interventions.

The structure of this report follows these three specific objectives.

## 1.2 Ethiopia's drylands – context and livelihoods

**Drylands:** A definition for the term 'drylands' is hard to establish. Two of the most widely accepted definitions are those of the Food and Agriculture Organization

(FAO) and the United Nations Convention to Combat Desertification (UNCCD). FAO has defined drylands as those areas with a length of growing period (LGP) between 1 and 179 days (FAO, 2000); this includes regions classified climatically as arid, semi-arid and dry sub-humid. On the other hand, the UNCCD defines drylands based on aridity index, which is a ratio of annual precipitation to potential evapotranspiration (P/PET). According to this ratio, drylands are defined as areas with an aridity index in the range of 0.05 to 0.65 (UNCCD, 2000).<sup>1</sup> According to these definitions, 40% of the world's total land area is believed to be located in drylands.

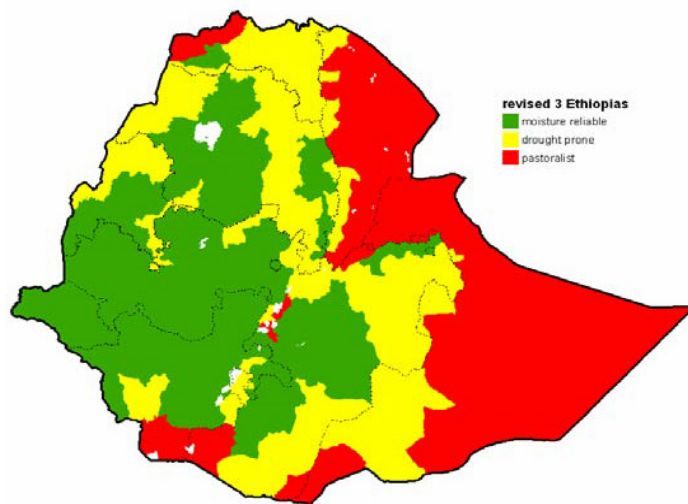
**Drought prone areas:** According to FAO (2004), a drought is defined as: a departure from the average or normal rainfall conditions; sufficiently prolonged (1-2 years) as to affect the hydrological balance; and adversely affecting ecosystem functioning and the resident populations. Drought prone areas are therefore areas characterized by variable amounts and intensity of rainfall. Drylands are impacted by high variability in rainfall, and also by the occurrence of prolonged periods of drought. According to the National Oceanic and Atmospheric Administration (NOAA) of the United States there are four different types of drought. Meteorological drought is a measure of the departure of precipitation from normal. Due to climatic differences, a drought in one location may not be a drought in another location. Agricultural drought refers to situations where the amount of soil water is no longer sufficient to meet the needs of a particular crop. Hydrological drought occurs when surface and subsurface water supplies are below normal. Socioeconomic drought describes the situation that occurs when physical water shortages begin to affect people. This report is primarily concerned with agricultural droughts.

**Dryland agro-ecology:** Agro-ecology is defined as farming that centers on food production that makes the best use of nature's goods and services while not damaging these resources. Dryland agro-ecology refers to agricultural practices in drylands. The agro-ecologies of Ethiopia's production systems are wide-ranging and diverse, and found in the arid, semi-arid and dry sub-humid areas. They are prevalent mainly in the north, east, central rift valley areas, south and southeastern parts of the country within very wide and diversified agricultural environments.

In the context of this study, the two terms (drylands and drought prone areas) are used interchangeably

because of the fact that drought prone areas are a subsystem of drylands, and drylands are characterized by the occurrence of frequent drought. The term dry also refers to moisture stress, which is often caused by drought. The major livelihood systems in Ethiopia's drylands include mixed crop-livestock systems, agro-pastoralism and pastoralism. The focus of this study, however, is on drylands with mixed crop-livestock systems, with limited mention made of agro-pastoral and pastoral systems.

**Figure 1. Three moisture regimes of Ethiopia**



In the Ethiopian context, drylands cover about 75% of the total land area of the country. They are home to a rapidly growing population that stands at about one third of the total Ethiopian population estimated at 35 million. The drylands are also home to large populations of livestock. It is evident that the drylands experience moisture stress during most days of the year, having only 45-120 days of growing season per year (Kidane et al, 2010). They are characterized by low and erratic rainfall with uneven distribution and frequent drought. Their altitude ranges from -124 to over 2500 m.a.s.l while rainfall ranges from 200 to 800 mm annually.

The drylands contain wide-ranging and diversified agro-ecologies and are endowed with high species diversity, both of animal and plant origin, presenting great opportunities for economic development. Vegetation is scattered, often degraded, and very sparse, leaving areas of the soil uncovered. In many dryland areas, except at the valley bottoms, the soils have low organic matter content, are highly eroded and poor in fertility. A

<sup>1</sup> According to both classifications, where the LGP=0 and P/PET < 0.05 the areas are hyper-arid zones or true deserts and not included in the drylands since they do not have potential for agricultural production, except where irrigation water is available.



high proportion of people in the drylands practice mixed crop-livestock farming systems and agro-pastoralism. The farming systems in Ethiopia's drylands are often smallholder based, with rain-fed agricultural production the basis of all subsistence farming in most parts of the dryland zone. As shown in Figure 1, Ethiopia can be broadly divided into three moisture regimes: moisture sufficient (green), drought prone (yellow) and semi-arid pastoralist systems (red).

Blueprint policies (or blanket prescriptions) do not work in the context of development, primarily because they constrain the flexibility that people need to survive and prosper. This has been the particular experience in the dryland areas of Ethiopia. However, it is now understood that although the often low and highly variable rainfall creates risky environments for households, people in the drylands have responded with their indigenous coping and adaptation mechanisms despite the challenges. Pursuant to this, the Government of Ethiopia remains very much concerned about the food insecurity and poverty prevailing in the dryland areas, as the recurrent droughts, floods and other natural disasters are posing serious national problems. As a result the government has now realized the importance of developing the dryland production systems in their fight against food insecurity, land degradation and poor economic development. One of the pre-requisites for this action is assessing why poverty and food insecurity still perpetuates among households in the drylands, and why all the development initiatives by the government and its partners have not been able to be supportive in sustaining improved livelihoods.

## 1.3 The study's approaches and methods

**Scope of the study and locations:** The study's scope covered a number of dryland agro-ecological zones, and specifically drought-prone areas ranging from highlands to lowland moisture stressed areas. The focus was on mixed crop-livestock farming systems in selected representative woredas in the Amhara, Tigray and Oromia regions. The three representative woredas of the three target regions were Zeway Dugda (Oromia Region), Kobo/Raya Kobo (Amhara region) and Wukro/Kilte Awlalo (Tigray Region).

For the assessment of the relevant agricultural interventions (such as the agricultural and livestock technologies introduced, their state of use and performance, as well as the identification of good

practices for the development of the drylands), the agricultural technologies developed by the Ethiopian National Agricultural Research System (NARS) and relevant CGIAR<sup>2</sup> institutes were inventoried and documented. These technologies were characterized and classified by discipline and their relevance assessed according to the needs of the stakeholders. Technology scale up and use status was inquired about, and major problems identified both via discussion and literature review. In its focus on technical agricultural development interventions the analysis covered the biophysical, policy and socioeconomic aspects.

**Description of sample areas:** The study sample areas included both rain-fed and irrigated parts of Ethiopia's drylands. The major form of agriculture is rain-fed agriculture, as is common in almost all dryland areas. An estimated 95% of dryland households are dependent on rainfall despite the erratic distribution. In most of these areas rainfall can only support farming for two months, usually falling in early July and terminating in late August. In some areas rainfall is available only for one month, mid-July to mid-August. The one sample drawn from an irrigated part of the drylands is an area where



Irrigation crop based - Kobo



Rain-fed crop based - Wukro



Rain-fed livestock based - Zeway

<sup>2</sup> Consultative Group on International Agricultural Research



surface or ground water sources have been harnessed for irrigation purposes. According to experts from zonal and district Offices of Agriculture, dryland households with access to irrigation are estimated to number less than 5%. Among the irrigation beneficiaries interviewed, some of the households were fully dependent on irrigation while most others used irrigation for supplementary sources of moisture along with rainfall. Households who were fully dependent on irrigation are largely engaged in the production of cash crops, such as fruits and vegetable production.

**Target groups and data sources:** To collect information for addressing the three core objectives, the study targeted the following primary data sources:

- Smallholder farmers: male headed and female headed households and youths
- Non-governmental organizations
- Private enterprises
- Government organizations: Regional Bureau of Agriculture, Zonal Office of Agriculture, Woreda (District) Office of Agriculture, Livestock Agencies, Kebele level development agents and Research Institutions

Other information related to the purpose of the study was collected from secondary sources including electronic and print media.

**Data collection tools and techniques:** Three standard data collection techniques and approaches were employed in this study covering: desk reviews of secondary information from published and unpublished sources; participatory approaches to collect primary information from target respondents; and case analysis. Key informant interviews (KII) targeted respondents including: Heads or representatives of Bureau of Agriculture, Zonal and woreda level Office of Agriculture;



Discussion with woreda office of agriculture and natural resources - Wukro

Development Agents (DA) and kebele administration; Male and female headed farmer representatives; Owners of private enterprises; and Youths. A checklist was used as a tool to facilitate discussions on specific issues related to technological exposure and its contributions, challenges and effects of dryland agriculture, and overall livelihoods. In the course of the study, KII were held for a total of 44 target respondents in three of the regions (see Table 1).

Focus group discussions (FGD) were also held with groups of agriculture professionals in the regions, zones and woredas, as well as with groups of men, women and youth in the communities. Discussion was facilitated using a checklist of provoking questions related to agricultural practices and challenges in dryland farming. As presented in Table 2, a total of 26 FGDs were held in the study areas.

**Table 1. Number of key informant interviews conducted in the target regions**

S.No	Institutions	Oromia	Amhara	Tigray	Overall
1	Regional Bureau of Agriculture	2	5	2	9
2	Zonal Agriculture Office	3	3	-	6
3	Woreda level Agriculture Office	2	2	2	6
4	Research institutions/centers	1	1	1	3
5	NGOs operating in the woreda	1	1	-	2
6	DAs at kebele levels	3	3	3	9
7	Farmer representatives (women, youth and men)	3	3	3	9
<b>TOTAL</b>		<b>15</b>	<b>18</b>	<b>11</b>	<b>44</b>



**Table 2. FGDs held in the target regions, zones and districts of drylands**

S.No	Institutions	Oromia	Amhara	Tigray	Overall
1	Bureau, Zonal and District Office of Agriculture staff	2	4	4	10
2	Women farmer group	1	1	2	4
3	Youth farmer group	1	1	2	4
4	Men farmer group	3	3	2	8
<b>TOTAL</b>		<b>7</b>	<b>9</b>	<b>10</b>	<b>26</b>



Women FGD - Zeway



Men FGD - Zeway



Youth FGD - Zeway

Case analysis was the third approach employed in the study for an in-depth assessment of model women, youth or men who had exemplary success stories in dryland agriculture and livelihoods. Samples of the case analyses are presented in Annex 1. These lessons and best practice experiences of innovative households and individuals were explored and documented to use both as a learning resource for fellow farmers and for possible scale-up to other areas. A brief guideline was prepared to help facilitate in-depth case analysis. In the course of the study, a total of 15 case analyses were conducted in the study regions.



Irrigation case analysis -Zeway



Rain-fed case analysis - Zway



# 2. FINDINGS - AGRICULTURAL DEVELOPMENT INTERVENTIONS

## 2.1 Initial assessment of livelihoods in the study areas

**Unsupported:** The dryland agro-ecological zones considered in the study are characterized not only by moisture stress, but also by inadequate infrastructure (such as vehicle roads, telecommunications, potable water supply, human and livestock health services etc.), as well as limited accessibility to large market centers, and inadequate access to agricultural and non-agricultural technologies. Consequently, the livelihoods of most of dryland farmers are extremely fragile. In many parts of the drylands, especially in agro-pastoral areas, households used to be dependent on livestock and undertaking crop farming is relatively recent. Households that previously sold live animals and milk products, such as butter and cheese, to purchase grain have had to start growing rain-fed short season crop varieties since the late 1990's with support from agriculture experts in response to climate change, shortage of grazing, population pressure and other factors. However, because of the severe droughts, their limited farming experiences, poor soil fertility to support crop production and other factors, many dryland households have instead depended on food aid for the last 2 – 3 decades.

Dryland households adopt a number of drought coping mechanisms, such as feed storage, selling cattle and shoats to purchase grain, borrowing cash from relatives, and renting out farmland for cash. Agro-pastoral households, especially those in the rift valley, also practice 'godantu' which is taking drought-affected animals to relatives in other areas where there is feed and water. Youths also seek daily labor employment in towns to support their parents.

**Results from irrigated farming:** In addition to undertaking rain-fed farming, some of the dryland households with access to irrigation also produce cereals (such as tef, sorghum and maize), chickpeas, vegetables, fruits and forage crops. In such cases households prefer long season varieties, which provide

high grain yields as well as biomass for animal feed. Short season varieties are not preferred as they get exposed to bird attack in the off-season when rain-fed crops are not being grown. Dryland households with access to irrigation have better food security as they produce crops up to three times per year. In the first season they produce tef from July to October (*kiremt*), in the second season chickpeas are produced from November to February with residual moisture, and in third season they produce maize from March to June. Those households with access to markets also produce vegetables and fruits. Following the introduction of irrigated farming however, it is evident that livestock population is declining in some parts of drylands as grazing lands have been allocated to the production of irrigated crops.



Problems of soil salinity around Lake Abijata

**Limited alternatives:** Some parts of drylands, especially in the rift valley, suffer from very poor soil fertility i.e. soil that is sandy and has poor water holding capacity. Even after the rains the soil gets completely dry after two days. Here livelihoods are almost fully dependent on food aid. Some households make attempts to generate supplementary incomes to purchase food grain through the sale of charcoal, although this exacerbates deforestation. Whilst goat and sheep rearing is more preferable to farming in these areas, the households

lack seed money to start such initiatives. They also often have to minimize the effect of droughts by selling their sheep and goats to purchase food grain. Even though credit services are in place, households complain of high interest rates from Micro-finance Institutions (MFIs).

**Food insecurity:** According to the perceptions of the dryland households, wealth categorization is determined according to the number of months a household can produce for consumption from its own farm. In most of the locations, a household is perceived to be well off if it can feed the family from its own production for more than six months. Medium level households can produce grain adequate to feed the family for 4-6 months and poor households are those that can feed their family for less than four months. In all cases, households have to depend on food aid in the months of food scarcity. The rearing of small ruminants along with credit services helps bridge food shortage. The household asset building (HAB) program of the Productive Safety Net Program (PSNP) is supporting households to build assets and strengthen their resilience, but not all of the households in need are beneficiaries.

**Gender assessment:** There are substantial differences in the involvement of women, youth and men in farming operations in the drylands compared to moisture surplus areas of the country. Whilst decision-making appears to be done jointly, income control is still dominated by the male household head. In the drylands women-specific initiatives are still at a minimum despite attempts to support them in garden farming, with poultry, dairy and vegetable production. Female household heads (FHH) were observed to be more fragile, with limited resources and lack of labor, the result of which is that most of them are dependent on the PSNP. FHH will share out their farmlands for a 50% share of the grain in most of the locations, and a 30% or 25% share in others. The FHH of Tigray region are especially disadvantaged, with about 75% of them renting out their land for meager shares as they do not have labor or oxen to work on their land. To minimize the effects of livelihood crises in drylands, some NGOs and agriculture offices are providing support to women through poultry farming and sheep and goat rearing. Women in the drylands face significant shortages of social services, such as a lack of grinding mills which forces them to travel 3 – 4 hours one way on foot to get the service. Women also suffer from lack of health services, which are also at a distance of 3 – 4 hours of walk.

**Youth:** In almost all of the locations studied, the initiatives to engage the youth in farming appeared to be minimal unless they were involved in family owned

farming. A government special revolving fund, with Zonal and District level Office of Agriculture technical backstopping, suggests some youth initiatives are in progress for hill and hill bottom farming. Initiatives such as apiculture, protection/closure of hills for sale of grasses; coble stone carving to supply town administration; and engaging youth in woodwork, metal work, poultry and vegetable production (with irrigation) were mentioned. During group discussions with youth, it appeared that the financial support pledged by the government has not yet come into effect in most of the locations. Another complaint was that they are forced to engage in pre-defined enterprises, such as woodwork, metal work and others, when it would be preferable if they were given the option of engaging in enterprises in which they are interested and which are more feasible in their localities.

**Progress made:** In some locations, however, there are clearly improvements made in access to public infrastructure compared to three decades ago; such as schools, health centers, water sources, roads and irrigation access. Improvements are also evident in terms of the introduction and use of agricultural and non-agricultural technologies, although expansion is still limited to specific locations. Following improvements in access to transportation, improved crop varieties along with associated packages have now been introduced to some parts of the drylands though the scale of dissemination is still limited. Access to small-scale irrigation in a few of the dryland locations has also motivated farmers' towards market orientation and growing of cash crops. Artificial insemination (AI) services, poultry and apiculture farming, dairy and fattening are also taking off in drylands even if accessibility is still limited to a few farmers. In areas where access to improved agricultural technologies has been created, especially in irrigated drylands, improvements are evident in food availability.

## 2.2 Crops, livestock and NRM production practices

The agriculture in the dryland areas studied had two distinct features: In areas where irrigation or supplementary irrigation was practiced, farmers focused on crops and kept cattle mainly for traction, and sometimes to fatten animals or produce dairy; whereas in dryland areas which depend on rain-fed agriculture, livestock was the major means of livelihood. Crops are not reliable enough, and almost all households kept mostly goats and sheep, with better off farmers keeping larger herds of cattle. The management of livestock in

these areas was generally extensive with no or very low additional inputs.

According to the sample area observations, the crops, livestock and natural resource technologies introduced to the drylands of Ethiopia have three main characteristics: Firstly, most of the technologies are not developed or designed based on the specific challenges and situation of the drylands and the needs of their communities. Secondly, although most of the extension activities are planned as packages, at the grass roots level these technologies are not well-integrated or extended to users as complete packages (for example the introduction of improved breeds without accompanying feed technologies). Thirdly, most of the technologies are reaching very few farmers and are not scaled up to the community.

### Crop production practices

**Improved crop varieties:** In the study areas improved crop varieties of cereals (sorghum, maize, tef and wheat), legumes (chickpea, mung beans), vegetables (tomato, onion and pepper) and fruits have been introduced. These major crops are grown both under rain-fed systems and irrigation/supplementary irrigation systems. The number of improved varieties introduced is very few in number however, in relation to the number of potential technologies generated and targeted for dryland areas. Farmers also have their own preferences for varieties, with their preferences considering many things beyond the grain yield.

Some of the varieties introduced in the drylands have had very good acceptability by the producers, like the tef variety Boset and the wheat variety Kekeba, while some others are very poorly accepted, for example short season sorghum varieties. Farmers will consider the variety's suitability to their soil types, temperature, the total biomass productivity, traditional irrigation systems, etc. Farmers also need crop varieties that are suitable to both irrigation and rain-fed conditions, but the number of varieties currently available that are suitable for both are only very few, and there are a few varieties introduced and demonstrated for crops like barley and most legumes. In irrigated agriculture, as the investment is very high, there is a need to introduce productive and disease/pest tolerant varieties, which reduce costs and are also healthy for consumers.

In developing crop varieties for drylands it is necessary to consider the different functions of the crop, including the use of residues as feed for livestock, conservation agriculture and other uses. Similarly, as well as

supplying to the market, varietal development also needs to consider its suitability as food for the target community in terms of its alignment to the culture and tradition of the people. Table 3 identifies some of improved crop varieties that have been developed and generated by NARS for dryland agro-ecology specifically for cereals and pulses. The introduction, promotion and dissemination of these varieties along with their associated management packages could help enhance farmers' livelihoods and resilience.

**Agronomic practices:** The genetic potential of improved crop species and varieties cannot be exploited unless integrated management practices are jointly used in a package; with water stress, low soil fertility, pests and diseases the major constraints which should be addressed concurrently (Kidane, 2005). In the study it was observed that intensive agronomic practices are practiced for crops cultivated under irrigation, although almost all fields are managed by furrow irrigation which has a lot of limitation in terms of water use efficiency and has long-term effects like salinity. Agronomic practices under rain-fed condition are mainly related to moisture management: Planting dates, fertilizer application dates and rates, and weeding are all done following the rains or at times of moisture availability.

**Fertilizer use:** Similar to other production systems in Ethiopia, soil fertility management practices in the drylands have limitations in terms of identification of the required soil nutrients and the rate of application. This has been a problem in many places for many years. In addition, the use of fertilizer in dry areas under rain-fed production can be highly affected by the availability of soil moisture (Kidane, 2003). Farmers in these conditions are reluctant to apply fertilizer, particularly when using credits, fearing for its efficiency and even the risk of complete crop failure.

**Plant protection:** The main crops of sorghum and maize in dryland areas are highly affected by *striga*<sup>3</sup> and stalk borer; the effect of *striga* can in some cases result in complete crop failure. Improved sorghum varieties that are tolerant to *striga* (Gubiye and Abeshir) have been developed by the research system and adopted by farmers. The other weed most prevalent in the dryland areas visited is *Parthenium*. *Parthenium* is a very notorious weed that cannot be eradicated easily as the seed bank stays in the soil for many years. It is suggested that cattle grazing on *parthenium* produce a bitter and undesired milk taste. Despite this, farmers do not appear to be trying to clear the weeds before flowering to minimize its immediate and long-term

<sup>3</sup> Striga is a major parasitic weed that causes severe damage to maize, sorghum and millet.



**Table 3. Crops varieties that better withstand moisture stress**

<b>Crop</b>	<b>Variety</b>	<b>Mechanism</b>	<b>Possible seed source</b>
Tef	Simada	Early maturity and tolerance	DZARC, Alem Tena PAs
	Boset	Early maturity and tolerance and productivity	DZARC, Adaa PAs, Minjar PAs.
	Cross 37	Early maturity and tolerance	DZARC, AlmeTena PAs, Meki Batu union
Maize	Melkasa 2	Tolerance and productivity	ESE, Meki Batu union
	Melkasa 4	Strong tolerance, early maturity	ESE, Batumeki union
	MH130	Tolerance, early maturity	Batumeki
	MH138Q	Tolerance, early maturity	Batumeki
	Melkasa 4	Tolerance, early maturity	Mekibatu
Wheat	Kekeba	Mild tolerance	Parastatal Seed enterprises, Kulmsa ARc
	Gambo	Mild tolerance	WererARc
	Kingbird	Mild tolerance	KARC, OSE, PAs
Sorghum	Melkam	tolerant	Melkassa ARC
	Teshale	tolerant	Melkasa ARC
	Goby	Tolerance	ASE
Soybean	Nova	Tolerance	Parastatal SE, PaweARC
	Williams	Tolerance	ESE
	Awassa95	Early escape and productive	Pawe ARC
Beans	Acos red	Early and tolerance	Acos PVT
	Kate B1	Early and tolerance	Melkassa ARC
	Kat Bg	Early and tolerance	Melkassa ARC
Mung bean	N-26	Super early and tolerance	Melkasa ARC
Cowpea	kanketi	Physiological tolerance	Melkassa ARC
Cassava	Kello	Tolerance	Hawassa ARC
	Qule	Tolerance	Hawassa ARC
Chickpea	Habru	Tolerance, suits double cropping	PAs, and DZARC
	Minjar	Tolerance , suits double cropping	DZARC
	Dalota	Tolerance, suits double cropping	DZARC
Grasspea		Double cropping and replacement	

Source: EIAR, Crop research directorate 2016

effects. Stalk borer, aphids, shoot flies, cut worms, sorghum midges and currently fall armyworm in maize are some of the common pests reported in these dry areas. Other diseases such as anthracnose, rust and smut also affect crops. The major and severe problems with tomato and pepper plants are bacterial wilt, late blight and some insects. Though very limited, the use of different pesticides in controlling different diseases, pests and weeds is practiced in some areas, especially where horticulture crops are intensively managed.

**Mechanization:** Improved technologies normally include the small tools and equipment that are introduced to improve crop productivity—these include row planters, threshers, tie ridgers, etc.—however most of these implements are not adopted by dryland farmers. The two main reasons given are that most of the implements have just been demonstrated with no further supply for scaling up; and that with some simple tools, like tef row planters, farmers complain about their inconvenience as the tools require very intensive labor. Some other tools, like the broad bed maker, require high power levels and local animals are not able to pull it on heavy soils. Nevertheless, in some areas like Tigray, some model farmers have purchased tractors and are providing services for other farmers. This is a good approach for the efficient use of machinery and helps reduce the burden on draft oxen.

**Storage and processing:** Marketing challenges for horticultural crops, like tomato and onion, are a key factor in most of the dryland areas. It was observed that market linkages are very poor and there are no improved preservation and processing technologies in place. The need for post-harvest management to minimize production losses, stabilize the market and promote overall efficiency is essential. It was observed that storage is not such a major issue because most of the farmers do not produce large amounts of grain.

Despite this, metal silos have been demonstrated and adopted by a few farmers.

### Livestock production practices

**Livestock breeds:** - Depending on the resources, environmental conditions and market conditions, breed improvement is often essential for dairy and poultry (layers and broilers). Activities towards breed improvement of ruminant animals (cattle, sheep and goats) were found in the study areas. The main breeds introduced to the drylands are shown in Table 4. It is suggested that, given the existing productivity status of the local breeds of beef, sheep and goats, productivity could also be tremendously improved through better feeding, health and other management practices (EIAR, 2017). In the current efforts of cross breeding local animals with improved dairy breeds (Holstein and Jersey), the use of AI, estrus synchronization and bulls has been tried. But according to the producers, the interventions have not been successful, especially in the rural farming systems. Use of Dorper and Awassi rams



Mixed crop – livestock systems in irrigated areas, Kobo

**Table 4. Main livestock improved breeds introduced (demonstrated) in the dryland areas of Ethiopia**

Livestock species	Breeds introduced	Service provision	Service providers
Cattle	Holstein Friesian (dairy)	AI and Bulls	Livestock Agency (LA)
	Jersey (dairy)	AI and Bulls	LA
	Boran (Beef)	AI and bulls	LA
Sheep	Dorper (meat and wool)	Distribution of rams	Research & LA
	Awasi (meat and wool)	Distribution of rams	Research & LA
Goats	Bore (meat)	Distribution of bucks	Research
Chicken	Bovans brown (layers)	Day-old & 45 days-old chicks	Research and LA
	Sasso (dual purpose)	Day-old & 45 days old chicks	Ethio-chicken
	Koekoek (dual purpose)	Day-old & 45 days old chicks	Research & LA

has shown relatively better adoption amongst sheep breeds. It was reported that 15 to 20 rams are distributed per woreda per year, but the supply lacks regular continuity and is not happening in every woreda.

**Feed technologies:** - The feed technologies, or improved practices with animal feeds/feeding, that have been introduced in the dryland areas are similar to other crop-livestock mixed production areas. The natural grazing lands are often degraded and unproductive but in some areas a system of enclosures is practiced and is successful. Crop residues are also

treated physically and with urea for animal feeding. Urea treatment is utilized to a limited extent however, and mainly by dairy producers. The agro-industrial by-products and concentrate feeds are utilized by those farmers with dairy and fattening animals, and are still not widely utilized by producers. The main sources of concentrate feeds are big cities; and in the drylands the supply is very limited, its accessibility is difficult and prices are very high. Different forage crops have however been introduced along with different agricultural and natural resource conservation practices (see Table 5). Most forage crops have been introduced

**Table 5. Common forage species demonstrated and introduced in dryland areas of Ethiopia**

Common names	Latin names	Main production methods**
<b>Annual grasses</b>		
Sudan grass	<i>Sorghum sudanense</i>	Irrigation / rain-fed
Oats (Cooler areas)	<i>Avena sativa</i>	Irrigation / rain-fed
Maize (Warmer wet areas)	<i>Zea mays</i>	Irrigation / rain-fed (food/feed)*
Sorghum (Warmer dry areas)	<i>Sorghum bicolor</i>	Irrigation / rain-fed (food/feed)*
<b>Perennial grasses</b>		
Elephant grass (warm wet areas)	<i>Pennisetum purpureum</i>	Irrigation
Panicum (warm wet to dry areas)	<i>Panicum species</i>	Irrigation / rain-fed
Rhodes (warm wet to dry areas)	<i>Chloris gayana</i>	Irrigation / rain-fed
Buffel grass (warm dry areas)	<i>Cenchrus ciliaris</i>	Irrigation / rain-fed
<b>Annual legumes</b>		
Lablab (Warmer wet areas)	<i>Lablab purpureus</i>	Irrigation
Cowpea (Warmer wet areas)	<i>Vigna Unguiculata</i>	Irrigation
Vetch (Cooler wet areas)	<i>Vicia species</i>	Irrigation
<b>Perennial legumes</b>		
Alfalfa (Wide adaptation)	<i>Medicago sativa</i>	Irrigation
<b>Browse trees</b>		
Pigeon pea (Warm dry areas)	<i>Cajanus cajan</i>	Field borders, fence lines
Leucaena (Warm wet to dry areas)	<i>Leucaena species</i>	Field borders, fence lines
Sesbania (Warm wet to dry areas)	<i>Sesbania sesban</i>	Field borders, fence lines

\*Maize and sorghum are strategically grown as food-feed crops, for example they are planted at high density and used to feed animals from the thinning of the young maize and sorghum plants. When the plant matures farmers feed green maize stalks after removing the ears for human food, and strip green leaves of sorghum as feed source. During the times of moisture shortage and signs of crop failure, complete use of maize and sorghum crop as feed is also practiced in dry areas.

\*\*Perennial forage grasses like elephant grasses and browse trees are planted on soil bands and on soil and water conservation structures in most dryland areas and enclosures.



Irrigated forage, Alfalfa, Wukro

on terraces as a physical structure to protect soil erosion as well as for the production of feed. Other species planted in enclosure areas include perennial forages and dual-purpose trees. Highly productive and quality forages, like elephant grass and alfalfa, are also produced using irrigation in fields, along the canals and on field borders. Some forage crops have also been planted in the backyards and along the fence lines. Multi-nutrient blocks (urea molasses blocks) have been introduced in Ethiopia to specially target supplementing very poor roughage feeds during droughts and emergencies, but the supply and availability of these multi-nutrient blocks was virtually absent in the areas visited.

**Animal health:** - The lack of adequate supplies of drugs and services are among the most challenging issues in most dryland areas. This is because the annual budget allocated is small and is not revolving. Accessibility of private drug shops and animal health services were problems in many of the kebeles visited. In terms of effective use of government allocated budgets for animal health, the experience of Amhara Regional State is exemplary: For the last five or so years the government has allocated a one-off budget for animal health services, and woredas opened a special account for this budget and revolved it. This resulted in an uninterrupted supply of drugs, vaccines and animal health services. This practice is also currently utilized with other input supplies and services, like fertilizers. Generally however the adequate supply of drugs and timely delivery of services and overall animal health prevention and control remains a perennial problem in the drylands. Producers raised issues of critical animal health problems in poultry, external and internal parasites, and predators.

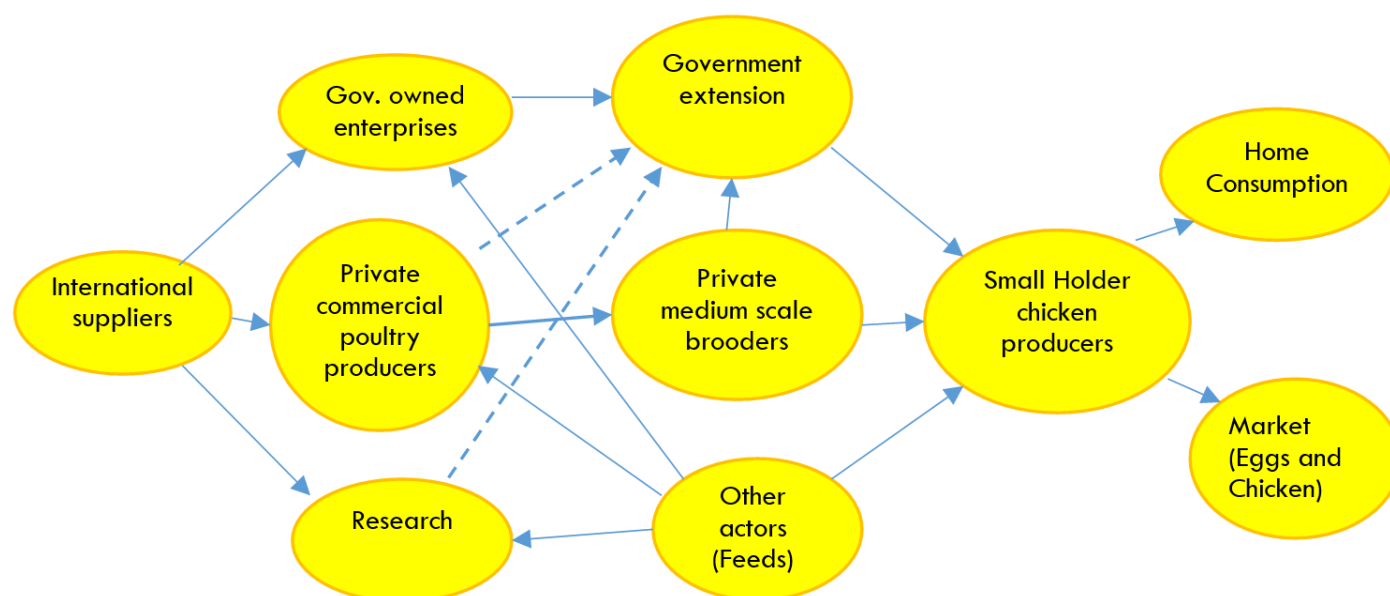
**Marketing:** - Efforts are underway to link dryland producers with good marketing outlets to get inputs for livestock production and for their trading products.

The woreda agriculture extension offices have tried to organize marketing cooperatives, but the marketing of live animals and livestock products is full of inconsistencies and problems. Challenges include a lack of adequate working capital, high inflation and an unreliable market, very low demand and prices during fasting periods of Christians especially in the Amhara and Tigray areas, absence of credits (high interest rates), poor quality of animals and products, and increased population—all of which make the market unstable. The demand for live animals and livestock products in the local and export market however is very high. Prices are continuously increasing in the local market, due mainly to the increased cost of inputs like feed. As well as strengthening marketing linkages for livestock products, it is important to have clear policies and guidelines for live animal and animal products' marketing at national level, covering market places, transportation and up to consumers.

**Poultry production:** - Improved poultry production technologies have been widely introduced and are largely successful in many dryland areas. This technology is suitable to smallholder farmers as it does not require large amounts of investment, land/space or labor, it has a quick return and is well aligned to government strategies (MoA, 2014; FDRE, 2011). Ethio-chicken at Mekelle poultry farm operates nation-wide, providing Sasso breeds, whilst researchers and other enterprises are working on different chicken breeds including Koekoek and Bovans Brown that have been widely adopted. The introduction of poultry technologies from Ethio-chicken has two steps: The first step is supplying day-old chicks to better off producers, youth and women cooperatives to brood up to the age of 45 days. Chicks have all the required vaccinations and the brooder receives enough standard feed for up to 45 days. This helps to minimize mortality of chicks under the relatively poor conditions. The brooders usually keep from 500 to 3000 chicks. The prices are fixed in all the regions. The 45-day old chickens are then distributed to smallholder farmers through the extension workers of the livestock agencies (see Figure 2). The major challenges indicated are problems of diseases and predators. The marketing of eggs and chicken is very attractive and not a problem. Studies on the economic feasibility of chicken production showed farmers needed to keep at least 50 chickens (Negussie *et al.*, 2006), however most farmers are keeping less than 20. To make poultry farming more profitable and bring meaningful change to farmers' livelihoods they should be encouraged to keep the optimal number of chickens and use adequate amount of inputs like feed and drugs.



Figure 2. Schematic presentation of improved chicken technology introduced in dryland areas in a Public-Private Partnership (PPP) approach



**Apiculture:** - Improved apiculture technologies—including modern hives, transitional hives, management, and honey and wax processing—have been introduced to small holder dryland farmers. These technologies are very successful in areas like Tigray but in other areas it has not been introduced or is very limited in number. Apiculture is seen as an important option to diversify and improve income levels as it requires a very small area, is less affected by weather variability, requires limited labor and has good productivity. The current demand and price of honey is also very attractive. Apiculture in the drylands is not aggressively promoted, except in Tigray, possibly due to the high cost of modern beehives and management skills. The technologies could be a good economic opportunity for women, youth and landless people. Ethiopia has now begun exporting honey to the European market generating foreign currency for the country.

### Natural Resources Management practices

Degradation of natural resources is the greatest constraint to sustainable agricultural development in almost all parts of the drought prone areas. Continuous land degradation, and associated soil fertility loss and water stress, hamper agricultural productivity and efforts at achieving food security and poverty reduction. Therefore, integrated natural resource conservation management is required to address the key problems, primarily water stress and low soil fertility in drylands. The Ethiopian government has identified the problem of land degradation as a priority action in all national and regional strategies and policies, including rural development, poverty reduction, conservation,

environmental policy and land administration (FDRE, 2011). In line with this there have been a lot of agricultural interventions made in research and development by the Ethiopian national research systems, CGIAR and other partners.

In this study it was observed that the primary focus to improve agricultural productivity is to avail water for irrigation and livestock production. Farmers are trying to conserve water available through:

- Construction of dams at different levels to collect water from all-season or seasonal rivers
- Making boreholes to harvest water and pump it out for irrigation
- Harvesting of rain water in ponds and other structures for supplementary irrigation, for livestock and other uses
- Applying efficient water utilization using conservation agriculture practices, and irrigation techniques, to minimize wastage

In addition to this, farmers are using different moisture conservation structures in rain fed systems like use of tie ridgers, water conservation structures, mulching, etc. Most water sources that are used for irrigation and livestock drinking in the study area visited were communal, and have utilization rules and regulations. However, these should be improved towards more efficient and fair usage of this precious resource. In several areas of the drylands soil conservation strategies, including terracing, construction of gabions and enclosure areas, have been practiced. But the extent that these technologies have been expanded



is limited and also varies from place to place. They are thought to be well progressing in the northern part of the country where the challenges of drylands are more extensive. In some areas improved integrated watershed management has also been practiced and success stories reported. In addition, efforts have been made to address degradation through afforestation, raising of seedlings, vegetative propagation and broadcasting in the degraded areas, which has resulted in rehabilitation and re-vegetating of the areas.

# 3. FINDINGS – AGRICULTURAL DEVELOPMENT CHALLENGES

## 3.1 Status of agricultural extension services in drylands

In Ethiopia the same extension approach is practiced across all agro-ecologies, farming systems and livelihood strategies. There is no specifically designed extension approach and compatible system for drylands, which are characterized by: limited access to infrastructure and public service centers; weather challenges; household food insecurity; and frequent drought occurrence and moisture stress amongst other problems. Most of the extension staff currently deployed in the drylands did not graduate from drylands focused degree programs. Resource allocation levels also do not consider the challenges persistent in drylands. Agriculture staff and DAs lack motivation when they have to take long journeys each day on-foot to reach more than 100 farmers. They also have to lobby farmers to participate in extension services, which cannot bring about sustainable change. This type of extension system cannot lead to commercialization.

In the drylands the DA to farmer ratio needs to be improved. According to district Offices of Agriculture, the DA to household ratio is 1DA:1300 households. In areas with limited infrastructure, limited access to transportation, poor communication and other services, this ratio creates enormous stress on DAs and erodes their determination to provide the expected services. It also prompts them to leave for towns looking for other opportunities. Due to the inconveniences, lack of attractive incentive mechanisms, and inadequate infrastructure and facilities in drylands, there is a very high turnover of DAs. Many of the rural kebeles face shortages of DA services, and as a result some regional governments, such as Amhara, have been forced to train 10th grade completed students for 7 months and then engage them as DAs. These DAs have little better knowledge than the farmers. According to the Bureau of Agriculture, 60% of the DAs in one of the dryland districts in Amhara region were seven-month trainees. Drylands extension services require dryland graduate experts. If not, perhaps a farmer-to-farmer extension type of approach would be a better option through providing training of trainers (ToTs) for progressive

farmers. In some parts of the drylands, such as Tigray region, there are no rural DA houses and they have to rent farmers' houses. Most of the kebeles are therefore without DAs. Transportation problems mean a DA could travel 3 hours a day to reach different kebeles and farmers, leading to loss of determination and contributing to high turnover. There should at least be one extension motorbike per kebele.

In the extension service system there needs to be greater practice of piloting new technologies before they are promoted and distributed for production in drylands. Technology packages for drylands and more moist areas are currently the same. The quota system of extension service provision has also become a cause for wrong reporting and communication. Poor and unrealistic communication of extension results has made planning misleading, with campaign based extension approaches becoming a reason to organize false reports. It is also recognized that there is inadequate gender and youth specific extension systems in drylands.

## 3.2 Adoption status of agricultural dryland technologies

In response to natural and man-made challenges in the drylands, which result in food and feed scarcity, governmental and non-governmental development organizations have been engaged in dryland specific technology generation, promotion and dissemination. The technologies can be categorized into crop based, livestock based and NRM dryland technologies, as briefly presented in subsequent sections.

### Adoption status of crop-based dryland technologies

#### Rain-fed drylands

Although the extent of dissemination and adoption varies from one location to another, improved varieties of dryland crops have been introduced to rain-fed drylands. However, improved variety use is largely dictated by rainfall availability. If the rain falls early, such as in April, farmers prefer long season (9 month) local

varieties for their high yield, large biomass and preferred taste. For example, farmers go for local sorghum varieties when rain commences early in the season, but they go for short season varieties (3 months) if the rain commences late in the season, such as in July.

Improved crop varieties that are adopted very well include improved maize. In the rift valley, improved maize varieties introduced include: BH 660, BH-540, BH-543, Melkassa series, Limu and Shala, each grown depending on rainfall availability for their maturity differences. Apart from maize, there are also improved wheat varieties, such as Havana and Hawi, introduced to drylands, plus several others that are not preferred for they are not easily thresh-able. The wheat-breeding program needs to consider thresh-ability during variety development.

In most of Ethiopia's drylands, more than 80% of maize growers have adopted improved maize varieties, with fertilizer, for their high productivity. When maize seedling density gets sparse farmers intercrop it with haricot bean, not only for efficient utilization of space, but also diversify income sources. On the other hand, the adoption status of improved varieties of other crops, such as tef and haricot bean has not gone as well (less than 30%) due to inadequate availability of quality-improved seeds. Even though unions, and public and private enterprises are engaged in seed production, they have not tapped into the demand from dryland farmers. Moreover, moisture stress in the late growing season (at flowering and seed setting stages) has also contributed to slow expansion of improved varieties in drylands. Among improved tef varieties introduced, farmers preferred cross-37 (locally named as '*siquar magna*') and they preferred mixed colored ('*burabure*') among the haricot bean varieties, for their adaptability, marketability and color. In addition to introducing improved varieties, row planting has also been introduced to drylands where it has worked well for maize but not other crops, such as wheat and tef, as it is a laborious activity. Therefore this technology should be supported with a row planter.

Inorganic fertilizer use in the drylands was reported to be less due to the moisture stress: Farmers refrain from buying inorganic fertilizers using credit because of the risk of debt consequences following poor crop performance at times of rainfall failure. In rainfed dependent drylands, inorganic fertilizer does not appear to be supportive at times of moisture stress, but it is highly useful in drylands areas that have access to supplementary irrigation.

### **Irrigated drylands**

In irrigated areas of the drylands the adoption status of improved crop varieties and associated packages, such as fertilizer, is going very well compared to rain-fed drylands. This is because improved varieties require adequate moisture throughout their growth stages and yield better than the same variety grown via rain-fed. More than 90% of the households had used improved maize varieties. However, farmers still grow local sorghum with irrigation for its high yielding potential, large biomass and preferred taste.

Apart from canal irrigation, spate irrigation is the common irrigation practice being adopted by dryland farmers. Farmers divert floods to irrigate their farmlands, the moisture of which is perceived to be helpful for crops in the later season if rains terminate early. This practice also appears to be helpful in enhancing technology adoption in drylands. The types of technologies introduced and their adoption status has been summarized in Table 6.

In Tigray region the adoption of improved crop varieties is still very low, less than 10%. The major reason is the shortage of quality improved seed supply and its high price. Because of this, most of the farmers are using grain as seed. Dryland farmers are scared of taking on improved seeds with credit because of fear of moisture stress, insects and disease attack, which can result in crop failure and expose them to debt. In some parts of drylands, including Tigray, households who have more land do not want to take credit for purchasing improved varieties as they can get incomes from alternative sources, such as sale of livestock. Those with limited land (0.5 ha or less) do not have any options other than taking credit.

In the study areas it was often reported that adequate awareness creation, or technical backstopping on how to use them, does not precede the introduction of improved varieties: They are distributed with little or no training about the technology. Farmers therefore have not yet built up confidence and the required motivation to use the technological packages. As a result, improved variety use has been limited to those progressive farmers who have had access to awareness creation trainings. Extension service provision on new varieties therefore appears to be inadequate in dryland farming systems.

**Table 6. Improved technologies introduced and adopted in drylands**

Crops	Improved crop varieties	Estimated adoption rate	Remarks
Sorghum	Birhan, Gubiye, Girana-1, Harmat, Yeju, Misiskir, dinkinesh, Abshir, Dekeba, wodakir	It ranged from 5% - 50% depending on locations	Girana-1 has expanded, though it is less tasty for home consumption and requires 4 months to mature. There is also a seed supply problem and the price is high. Hormat tolerates striga and it is long maturing, but it requires supplementary moisture in late season. Short season varieties are reported to have low biomass yield for feed.
Tef	Boset, Quncho, Zobel, cross-37 (Siquar Magna), Tsedey	Ranged from 10% - 90% across various dryland locations. Irrigated drylands have appeared to be better adopters than rain-fed while rainfed the least.	Bosset is preferred in some locations and cross-37 in others. Kuncho is a bit late and gets caught by frost in October in highland drylands. Marketability (white color) is the key feature for preference. It has also required supplementary irrigation in later season. Because of this, not expanded. Cross-37 has almost become local in some of the drylands. Local teff has almost been replaced by improved varieties.
Maize	Melkassa varieties series (M-1, M-2, M-3, M-4 etc), Pioneer, BH-660, BH-540, BH-543	4% - 90% depending on irrigation access. Almost all adopted in irrigated drylands while the least adoption is in rain-fed drylands.	Pioneer is preferred for its high yield and because seed is available. Improved maize is usually grown in irrigated dryland areas.
Wheat	Kekeba, Danfe, Digelu, Agolicho, Mekele-1, Mekele-2, Haba, Hawi	15% - 80% depending on location	Kekeba is preferred for its high yield. Mekele varieties are preferred in Tigray region, but they are long maturing (130 days) requiring supplementary irrigation later in the season. Although Kekeba is being affected with rust, it gives some yield even when rain terminates in late season, which local varieties can't do.
Barley	Holker, Estayish, Agegnehu	About 10% on contractual basis	Location specific. The problem is with seed availability and breweries not collecting the supply timely.
Chick pea	Arerti (and others whose names they could not remember)	Has not gone well and limited to specific areas	Further promotion and seed distribution is required.
Major fruits & vegetables	* Papaya, mango and banana	It ranged from 5% - 50% depending on locations	Girana-1 has expanded, though it is less tasty for home consumption and requires 4 months to mature. There is also a seed supply problem and the price is high. Hormat tolerates striga and it is long maturing, but it requires supplementary moisture in late season. Short season varieties are reported to have low biomass yield for feed.



Crops	Improved crop varieties	Estimated adoption rate	Remarks
NRM technologies	Lime	10%	Very low supply of lime due to low production capacity of the crushers, especially the one at Dejen, which affected further adoption.
	Geo-membrane based water harvesting (horeye)	15%	It is perceived to have failed in many of the drylands. It costs as much as 9000 birr to establish one water harvesting well with geo-membrane. Farmers get it from MoALR with birr 3000 and sell it for >10,000 birr. Because of this, theft is also becoming another problem. A geo-membrane well is also liable for accident and it wears down within 3 – 4 years requiring replacement, which is not easy. Evaporation is also high & does not keep water for long.
	Water harvesting structure with cemented wall	Rare in some areas while it has gone as high as 25% adoption in some others	Instead of geomembrane, plastering the wall has worked out better. Farmers take cement with credit.
	Dome water well with closed inlet	<1%	Highly preferred in drylands: no evaporation since its opening is closed and it can hold a lot of water. But unaffordable for smallholders (as high as 100,000 birr to establish a single structure)
	Physical conservation structures	40% - 60% sustained. Better in highlands than lowlands.	Conservation works are more successful in highlands than lowlands. Since lowland households own many animals, it appeared challenging to maintain physical structures and to keep hills closed, because they feel cut-and-carry doesn't help for animals of large number.
	Watershed users association	It is not known in some areas, such as Oromia; 70% of watersheds have established association in others, such as Amhara.	It has commenced as a campaign in all watersheds rather than piloting. Mostly, it is not also based on scientific approaches.
	Community ponds	It has gone well in most of drylands and highly preferred for animal drinking	Farmers still require more of such ponds. Excavator machines are required to dig the well.
Mechanization	Tie ridge	About 35%	Most of the farmers complained of supply problem of tie ridges despite the demand.
Livestock technologies	Improved forages, such as elephant grass	Only limited to irrigated drylands	Cut-and-carry is common practice in irrigated drylands.
	Cross-bred cows	<1%, because they are limited to sub-urban and irrigated drylands	Crossbred cows are adopted mainly in locations where there is access to markets, such as peri-urban drylands.

## Adoption status of livestock-based dryland technologies

Although their adoption has been limited, attempts have been made to introduce livestock-based technologies in drylands with a focus on feed. In some of the locations, Office of Agriculture staff have been advising farmers on how to make dry feed storage and conservation techniques for use at times of drought. In some other locations improved livestock technologies have been introduced, such as crossbred cows and feeding using elephant grass, although this was provided for only a few farming households. These households tend not only to be located in sub-urban and irrigated drylands, but also they are relatively well off and able to afford the purchase and management of crossbred cows. In the drylands, a trend is evident that livestock population per household has declined over time, however Central Statistical Agency data for almost every year indicates overall growth of livestock populations in regions and across the country (CSA, 2016).

Poultry is another livestock-based technology that has been successfully introduced and disseminated to the drylands. Layers, broilers and multi-purpose chicken were introduced through government support and NGOs to rural drylands. Expanded adoption of improved chicken is however constrained by unaffordability of adequate feed supply by households. In general, expanding livestock technologies in drylands is challenging for a number of reasons, such as climate change (expressed by frequent drought), which results in serious feed shortages and death of animals. Moreover, dryland households do not have many options other than selling livestock (de-stocking) and purchasing food grain at times of drought. Limited economic capacities of households to afford purchases and management of improved livestock also appeared to be the other major factor that restricts adoption of livestock technologies.

## Adoption status of NRM technologies in drylands

The most crucial intervention in drylands that should precede other technologies appears to be natural resource management (NRM) technologies and practices, with a focus on soil and water conservation. NRM related technologies and innovations that have been widely adopted in drylands included the following:

**Area enclosures:** closure areas and the associated 'cut and carry' system of feeding is being practiced in almost all dryland areas. Dryland districts have thousands of hectares of land, which are mostly hills and mountains. This innovation has gone very well in most of the districts visited where the community has also

established a committee to look after the management of closed areas. Especially in highland drylands, the recovery of flora and fauna is evident. There is also *in-situ* conservation of certain tree species in closure areas.

**Physical soil conservation structures:** structures such as terracing, stone and soil bunds, check dams and others, have also been progressing well in the drylands. These structures have been expanded more on communal lands than individual farms. In most of the drylands, hills and hill bottoms have been well maintained with such structures. However, the sustainable management of physical structures appears to be better in the highlands than the lowlands because of the fact that in the highlands erosion problems are more severe here, and the livestock population is also less. For instance, in the drylands of Amhara region, soil loss was reduced by 56% in locations where NRM structures have been constructed. Soil and water are reviving, fauna is returning and flora regenerating. The moisture holding capacity of the soil has also increased. If there is less severe erosion it is a disincentive to sustain physical structures and the considerable numbers of livestock in typical lowlands also makes it challenging. Even in drylands that are characterized by flat topographies, NRM structures are scarce. It was also reported that NRM conservation and construction of physical works is better on plots of farmers under the age of 40 than those more elderly.

**Water harvesting structures:** The water harvesting structures introduced to the drylands include open wells (with the use of a geo-membrane or cemented wall locally known as *horeye*), domes locally known as *baska* (closed well), community ponds and small-scale catchment dams. These structures are all liked by farmers except open wells with geo-membrane linings whose adoption appeared to be very low due to several factors. Farmers purchase geo-membranes from the government at a subsidy cost of only about 2000 Birr or less, and they can sell it at a higher price >10,000 Birr. Because of the high demand for geo-membrane in towns for roof covering it encourages theft, and farmers do not want to take a risk by leaving the geo-membrane in open well structures. Other reasons include fear of children and animals falling in the open structure, wild animal damage, and replacement when it wears down or is damaged, etc). Dome shaped closed water wells, with their walls plastered with cement, are preferred for their safety and higher water holding capacity (about 120m<sup>3</sup>) throughout the year, however their construction and maintenance costs are very high. Community ponds are the most preferred structure for relieving water shortage for animals, but since it is often constructed with heavy-duty excavator machines, the community demands more support from government and/or NGOs. Small-scale catchment dams are also constructed

mainly with government support in a few dryland locations, but mainly for irrigation purposes. However, these dams get filled with siltation and soon their water holding capacity declines or stops functioning.

**Watershed development:** Thousands of watersheds have been delineated in parts of drylands, especially in Amhara region. The establishment of a watershed committee to manage watersheds is a good practice although they can suffer from the poor coordination and networking of the various departments involved; such as crops, livestock, NRM, infrastructure (water, health, roads, communication) and others. A watershed users association (WUA) prepares plans, implements and takes care of maintaining the structures. There are more than 23,000 watersheds in Amhara region, out of which NRM structures have been built in 90% of them, and WUAs established for 55% of them. WUAs generate incomes from members' contributions, sales of grass, fines and other sources. In one kebele, there could be 3 or more WUAs. The establishment of WUAs in Amhara region was approved through proclamation in 2012 and enacted in 2013. While watershed management requires integration of various disciplines, sectors and ministries, this is not always the case. The community also has to develop a sense of ownership of the watershed to ensure sustainability of achievements.

### 3.3 Factors affecting agricultural technology adoption in drylands

The major reasons for low levels of agricultural technology demonstration and adoption are as follows.

**Inadequate identification of appropriate technologies and prioritization:**

There is little work done to identify, test or demonstrate the most appropriate technologies in the drylands. This is also a lack of follow up action for activities which require looking in terms of their associated problems of adoption or the reasons why they fail in their intended purposes. Introduction of technologies also lacks prioritization or logical progression; for example, water conservation technologies do not precede the introduction of improved varieties.

**Lack of technology needs assessment and piloting:**

Most of the technologies have been introduced without making adequate needs assessments or on-farm demonstration. This has resulted in failures and consequently sparked doubts on subsequent technologies. New introductions should have been preceded with demonstrations and consultations with

the community. The economic capacities and interests of dryland households should have also been assessed at the outset. This way, appropriate technologies could be introduced and adoption will be sustainable.

**Lack of input supply:** Improved crop varieties and other technologies are developed with a lot of resources and time spent. Once they are proved to be working well, seeds and other inputs should be available at the right time, in the target area, with required quality and enough quantity. Unfortunately, proven technologies are not widely taken up as expected by the farmers visited in the study areas. The major factors affecting technology adoption include lack of access to inputs such as: seed of improved varieties of the required quality and sufficient quantity, fertilizer, agrochemicals and farm implements. Consequently, farmers recycle seeds that do not provide high yields, or they also get mixed with other varieties and lose their vigor and marketability. Other inputs, like concentrate feeds and veterinary drugs for successful technologies like poultry and dairy, are also not easily accessible. The costs are also not affordable, which critically limits their expansion.

**Inadequate and inefficient use of fertilizers:** Soil fertility is a declining asset in much of the semi-arid region and particularly in dryland areas. Inorganic fertilizer supply and use is also lower compared to more high potential areas. The use of fertilizer is not only low, but also in many areas the recommended use is regardless of the context, which makes its efficiency very low in dryland areas. Knowledge based use of fertilizers according to the type of production practiced (such as under irrigation or rain-fed, soil fertility status and type of crop) would improve efficiency and overall crop productivity. Fertilizer should also be used in combination with organic manure or other organic residues to improve soil fertility problems on a sustainable basis. In addition, the effects of fertilizer application are enhanced with the use of improved varieties on which a multiplying effect on coefficient of response is obtained. Low soil fertility, due to very limited use of inorganic fertilizers, limits the benefits from improved varieties and other inputs, and climate adaptation in the dryland areas.

**Limited use of farm implements for efficient and timely performing of farm activities:** Labor is a major constraint in the drylands for conducting farm activities, and appropriate farm implements are required to perform agricultural activities in a timely manner. This is particularly true in crop production since length of growing period in the drylands is generally short and most farm activities have to be performed in a very short period of time. Lack of multi-purpose implements is constraining the adoption of agronomic technologies.

Several improved implements have been developed including the Erf and Mofer attached moldboard plough, tie-ridger for moisture conservation, winged plough/ sweep for secondary tillage, sub soiler, hand metered row planter, tef drilling machine, wheat planter, cassava chopper, metal silo, groundnut lifter, potato digger, multi-crop thresher, manually operated maize sheller, etc (Girma Moges, 2013). Most of these implements have been demonstrated to producers, however they are not sustainably supplied and utilized. Some of these implements are also not affordable, as indicated by the model farmers interviewed during the study.

#### **Limited empowerment of the lower level agriculture**

**offices:** Drylands require the closer monitoring and support of not only DAs but also district level agriculture experts. However, only a meager operational budget is allocated to district agriculture offices, so there is inadequate availability of field vehicles or motor bikes, and DAs in almost all of the dryland kebeles have no means of transportation to reach many of the farming households located far apart. The very high farmer to DA ratio has affected the poor adoption of technologies with, for instance, one DA expected to reach to 90 – 150 farmers per day travelling on foot to villages located far apart. This is not only impractical, but is an example of poor extension planning with DAs failing to provide adequate extension advice. It has also become discouraging for DAs and agriculture experts to provide close monitoring and support to dryland households. (The high turnover of DAs has already been reported as an acute problem of dryland kebeles). The high costs of imported inputs due to long transportation routes, high taxes and transaction costs also make it uneconomical to use them, especially in drier areas where the risks are greater. Poor infrastructure also imposes constraints on marketing perishable produce.

**Limited awareness and skills:** - It was observed that most of the actors working in the drylands lack proper awareness and skills in demonstrating and providing services. Although this might be common to other areas, it is more serious in the drylands. A good example is where the AI technicians have very limited skills. Many of the extension workers do not have the experience and skills in how to cultivate and utilize forage crops, especially agronomic practices. When new technologies are introduced to drylands, it is frequently not preceded with adequate awareness creation and promotion to help raise demand from farmers. Similarly, producers are poorly aware of improved technologies and as a result they are reluctant to adopt and test them. This is because training programs are not focused and practically oriented, but rather they are theoretical and general.

**Lack of access to credit services:** - Credit services are

not available for resource-poor farmers to purchase the inputs they need for increasing crop production—such as improved seeds, fertilizer, implements, chemicals etc. Credits available for farming through MFIs is only small-scale, not more than Birr 5000, whilst households engaged in irrigation require a credit access of far more. For instance, it requires investment costs of about Birr 240,000 to establish irrigated vegetable farming on a hectare of land. Medium scale credit is also required for establishing fattening, dairying and poultry farming. There should be more favorable access to medium scale credit services to expand irrigated farming, especially to areas located in the outskirts of towns.

**Poor marketing linkages:** - Improved technologies will only be adopted by producers if they can bring about increased productivity and income: If markets are not available then producers will not have incentives to use inputs or adopt improved technologies. The major challenges of crop and livestock marketing described in the drylands are:

- Seasonality of product supplies, particularly for perishable products such as milk and vegetables, creates price variability and unstable marketing conditions, for instance during the Orthodox Christian fasting periods. On the other hand, a low supply of products during non-fasting periods inflates the prices.
- The high cost of inputs inflates the price of the products, lowering the demand for these products in the market. A good example is the fattening of steers, and eggs and vegetables, all of which require high costs to produce that their selling price in the market is not sufficient to cover.
- There are no strong marketing linkages for inputs and products of agricultural products
- Most of the infrastructure, like roads, in the drylands are poorly accessible, which has its own effect on the supply of inputs and delivery of products to potential markets
- Some agricultural products, like milk and vegetables, unless they are supplied to the market at the right time require high costs to maintain impacting the producers
- Absence of processing and value addition facilities to stabilize marketing and a consistent supply of products
- At times of harvest there is a supply glut and prices fall to a level that cannot even cover operational costs. For instance, maize that should have been sold at Birr 1000 per quintal is being sold at Birr 300 only.

The role of brokers in the marketing chain has deteriorated the normal functioning of markets. Unless processing companies are established, market problems will not be solved on sustainable basis.



Moreover, quality products should also be exported with producers licensed to produce quality products as per the standards required. A case has been raised that Ethiopian Airlines imports about 2000 tons of vegetables per day for its catering. If Ethiopia can produce standard products and supply on a sustainable basis, import substitution can be made, benefiting both vegetable producers and the government.

#### **Lack of tailored extension approaches and**

**inadequate monitoring and support:** Drylands face different challenges to other parts of the country but, as previously stated, compatible extension approaches have not been designed for dryland farming. In addition the introduction of improved technologies has not been strongly complemented with close monitoring and support to DAs and agriculture experts. Considerable numbers of kebeles in the drylands are without DAs except for those located in accessible areas and peri-urban centers. There has also not been joint monitoring and evaluation of the progress of interventions along with various agriculture departments or district Agriculture Office experts.

#### **A highly top-down campaign approach of technology**

**introduction:** Annual plans are often top-down without consideration of the reality and potential on the ground. The community is not often consulted and expert inputs at district levels are also rarely considered. Instead, activities and interventions are often made for implementation for a year or two on a campaign basis without taking sustainability into account. Technologies and their inputs are introduced, demand is raised, but there is insufficient supply in subsequent years. A focus on short-term gains without establishing sustainability mechanisms occurs with seed systems, capacity building issues, M & E, market linkages, sustainable technology supply and others. The technical backstopping and closer support fades away in later seasons. With campaign-based interventions, there are also cases where inappropriate technologies are introduced.

#### **Ineffective introduction and promotion of**

**technologies as packages:** In the drylands it is essential to introduce and adopt a technology as part of a full package rather than as separate entities. For example, farmers should be advised to adopt improved varieties not only with fertilizers but also with soil and water conservation practices, water harvesting, saving culture and others. However, it is often observed that technologies are demonstrated and scaled out in fragments: improved varieties are introduced to drylands without their associated inputs, and improved breeds of livestock are most often not accompanied by input supplies like feeds. When dryland farmers are not adequately supported to adopt technologies as

packages this results in limited benefits accruing from their investments and discouragement for adopting them in subsequent years.

#### **Unrealistic information and bottom-up reporting:**

When information is reported upwards it is less realistic and often exaggerated. This has led not only to distorted planning of extension services in subsequent years, but also resulted in wasting of resources. At the same time it has raised suspicion and concerns among dryland households.

**Limited strategy implementation:** Even though there is a strategy for dryland agricultural development in some of the dryland districts, there is no manual or detailed implementation plan that is adequately translated into action.

## **3.4 Socio-economic problems and challenges in drylands**

Dryland agro-ecological areas feature a range of socio-economic challenges. The most common ones include:

**High population pressure:** High population per household is exacerbating poverty of dryland households. Large numbers of unemployed youths are also the consequence of this problem, which results in migration both within and outside the country. Limited employment opportunities in drylands are also an issue.

**Less economic power and resource limitation of households:** Dryland households often face financial limitations in meeting their cash demands for inputs and various other social obligations. Resources, such as livestock, have diminished due to frequent drought, consequent destocking and sale to purchase food grain. One farmer used to own 200 – 300 cattle in earlier days, but now 10 or fewer animals are owned, leaving dryland households fragile and less resilient to climate change shocks. In parts of the drylands the living conditions of farmers is one of extreme poverty. These farmers lack confidence and courage with the routine activities of agriculture. Some of them have nothing to invest in their farm, and paying for new technologies is not possible for them or the use of recommended practices. These factors, coupled with the natural features of low and unreliable moisture availability, and high population growth in the drylands, make communities incapable of using improved technologies and families incapable of producing food.

**Critical shortage of fertile land per household in drylands:** Land shortages exacerbate economic problems and worsen the capacity for resilience. In

drylands where the soil does not hold water technology use has become less effective.

**Lack of strong commitment of dryland farmers to practice soil and water conservation measures:**

No technology can be sustainably adopted in the drylands without practicing soil and water conservation structures. However, a large proportion of dryland households do not demonstrate commitment to conservation structures on their own farmlands. Despite the existence of a policy framework that introduces obligations onto farmers to practice soil and water conservation measures on their farmlands, it has not been enacted. Free grazing of animals adds to the lack of sustainability of soil and water conservation structures. Soil often has limited moisture that is inadequate to support growth of improved varieties and discourages farmers from adopting these technologies.

**Less market orientation of dryland farmers:** Due to their focus on food self-sufficiency, most of the farmers in the drylands are not market oriented. They do not opt to intensify input use, engage in soil and water conservation, adopt technologies or produce for both the market and home consumption.

**Attitudinal issues and dependency syndrome:** In addition to the climatic and infrastructural challenges constraining productivity, crop husbandry is a relatively new experience to dryland households. Dryland farmers are not committed to facing its challenges and striving for livelihood improvements. Instead, they tend to look for food aid even during good seasons. In much of the drylands food aid has become a stable means of livelihood. This is an obstacle to introducing technologies and ensuring adoption on a sustainable basis.

**Over exploitation of resources and discharging of dangerous chemicals by large-scale commercial investment farms:** Even though this issue is location specific, it is becoming evident that expansion of large commercial investment farms on favorable lands of the drylands (those with access to irrigation) is exacerbating the poverty of households. For instance, drylands located across the highways in the rift valley are now largely occupied by large-scale investments. In such locations the large-scale investments displace the farmers. It is also reported that drying up of rivers in the drylands is perceived to be due to over-irrigation by these commercial farms, such as the flower farms in the rift valley. Harmful chemicals being discharged from such commercial farms are also polluting water bodies that are used for drinking and irrigation by lower stream households. This has created severe discontent not only among the farmers but also among Offices of Agriculture and other institutions in the district.

**Less accessibility and limited infrastructural facilities**

**of drylands:** A large proportion of the drylands are inaccessible for implementing development activities. In most of the locations there are no vehicle roads and settlement patterns of farming households are scattered making interventions challenging. It is also common to find a large proportion of drylands with limited access to irrigation, electric power, human and animal health services, potable water for human and animal drinking, high schools and other services. In areas with access to irrigation, electric power interruption has become an acute problem resulting in failure of crops. Maintenance service of malfunctioning pipelines has also become a severe challenge in such areas. In parts of the drylands without access to infrastructural services it is common for there to be a high turnover of school teachers. Youths are forced to terminate their education at elementary levels and become unemployed in neighboring towns.

**Farmers' perceptions that trainings are less supportive**

**to their problems:** Farmers in the drylands require special capacity building support to help address their multi-faceted challenges. The approaches and skills used in areas with adequate moisture may not hold true to drylands. Farmers in lowland drylands have begun to develop the attitude that most of the trainings being facilitated to them are not adequately tailored to their needs and are fed up of routine meetings and unsupportive trainings. When called for meetings, attendance rate is <50% with those who participate not being attentive. According to one district Office of Agriculture, less than 10% of them will apply what they are taught and advised. This has become a core challenge for development and requires awareness raising and trust building ahead of time.

## 3.5 Specific constraints to agricultural production by women and youth in drylands

### Women

Common to other areas, women in the drylands are constrained by cultural, social and economic conditions. They are always responsible for several on-farm and off-farm activities. Some more specific issues in the dryland areas include:

- Drylands are always exposed to frequent drought and famine. Under these conditions women and children are the first victims.
- As a result of limited agricultural activity, income diversity for women is very limited and this makes it very difficult for them to take care of their children and the family.

- In some parts of the drylands there are no grain mills around and women need to travel long distances.
  - Female-headed households are not usually benefitting from their cultivated land. This is because of poor financial capacity or absence of family members to do the plowing and other field activities. Under such conditions women rent their land out to other farmers, or enter into a contractual agreement with the producers. The agreement will vary from place to place, depending on their role in the different farm activities and purchase of input supplies, but women will often only get a quarter or a third of the produce.
  - It was also indicated in many places that the policy and all the trainings talk about encouraging and supporting women, but this is not the reality on the ground. Access to extension services, training and credits are reported to be gender biased.
  - Women are engaged in most of the livestock production activities, in addition to the burden of looking after children and the responsibilities in the house.
  - Water is always the center of focus in the drylands. Fetching water for drinking and home use and sometimes for animals staying around the homestead is a big challenge for women. In some areas there are boreholes but in other places there are not. This might be due to the absence of interventions or the quality of the water is not potable. It was indicated that the water quality is getting worst due to climate variability, for example in some areas around Zeway and Abjiata.
- urban dairy are an option. However, as stated above, the main challenges are lack of finance, skills and reliable markets for products and input supplies and services.
- Shortage of land, especially in more productive and irrigated areas is also a critical constraint to the youth, along with lack of resources, facilities and credits with affordable interest rates.

## Youth

- One of the constraints of youth reported by older men is that currently all the children who have been to school become detached from their traditional livestock-keeping activities. Some youth discontinue their education due to absence of high and preparatory schools or lack of support from family or extended families. Unfortunately, most of these young people do not have an interest to go back to farming.
- Livestock keeping needs full commitment and attention all the time, and in most cases one has to follow the livestock and look after them in harsh environments. Now the youth do not want to do these activities. They want other types of jobs, like government jobs, migrating to Middle East countries (both male and female), which the family is also encouraging, whilst some others are trading goods.
- For the youth who want to engage in crop and livestock production to quickly generate money, and undertake relatively easy to work with improved management; areas like vegetables, poultry, fattening of cattle and small ruminants, and peri-

# 4. FINDINGS – AGRICULTURAL DEVELOPMENT GOOD PRACTICE

## 4.1 Lessons learnt from reviewing agricultural technology introduction in the drylands

In the course of this study into dryland agriculture in Ethiopia the following findings were significant concerning the introduction of technology:

- Dryland agriculture requires its own specific approach and interventions that are different from other agro-ecological areas. The 'one type fits all' extension system does not work effectively in drylands, which requires a specific extension service system that takes the reality on the ground into account.
- Planning development interventions in drylands should be more consultative and participatory, involving the community and development partners. Agricultural research institutions, higher learning institutions, Bureau of Agriculture and Offices of Agriculture including district levels, private and public input suppliers and others, should take part in making sustainable and effective development plans for drylands using different platforms, such as the Agricultural Development Partners Linkage Advisory Council (ADPLAC) and others.
- Once joint development plans are made for the drylands, implementation and M & E should also be more participatory, involving a range of development partners along the value chain of the commodity or service under consideration.
- Package-based technology introduction to the drylands should be strengthened, including all associated inputs and services; such as improved varieties, fertilizers, pesticides, soil and water conservation measures, water harvesting, establishing market linkages, closer monitoring and technical support, introducing and strengthening saving cultures, and others.
- Interventions in the drylands should not be made on a campaign basis focusing on short-term returns,

but should be well designed and participatory with a focus on sustainability. Attempts made so far have been largely short sighted and unsustainable.

- A crucial finding is that, in view of the food insecurity and climate change challenges over recent years, dryland households have built up a dependency syndrome which deters them from their commitment to face challenges and strive to get out of the vicious circle of poverty. Therefore, there is a strong need to work on attitudes of dryland households.
- Adequate awareness creation, information sharing and relevant capacity building to beneficiaries should precede technology introduction and dissemination, without which farmers will lose interest in adopting new technologies and innovations.
- Dryland agro-ecology is not homogenous in its features. A large proportion is rain-fed while a small proportion is irrigated, and both face different challenges requiring different interventions and strategies.
- For most dryland households, especially those in lowlands whose livelihoods used to be dependent on livestock, crop farming and land plowing is a recent experience of not more than 2 – 3 decades. This is the case in the rift valley drylands where there are cases of dryland households opting to rent out their farmlands for highlanders. Therefore, a strong focus should be made on enhancing farming skills of dryland households.

## 4.2 Technology and development good practice in dryland farming communities

The demand for agricultural technologies and development interventions in the drylands are many. There will be a need for prioritization, and at the same time the integration of interventions to bring about meaningful change. Knowledge and skills in the different aspects of crops, livestock and natural resource



management are currently remarkably limited; but from what has been observed in the dry areas, and from the suggestions made by key informants, producers and other relevant actors, the following activities are those most likely to be successful:

**Strategic and land use planning:** - To ensure successful development of the drylands, both under irrigation and rainfed conditions, there is a need to have very well developed strategies, implementation plans and projects. It was reported that currently, in most of the agricultural development plans, the dryland areas are marginalized and considered last in the priority list. In developing the strategic development plans for the drylands, emphasis should be given to land use planning. The drylands have high potential areas for irrigation, for rain-fed agriculture, for livestock production and for afforestation (EARO, 2000). Land use plans with supportive technologies of efficient water use, natural resource conservation, and sustainable intensification of crop and livestock production should be the starting of agricultural development.

**Investment in infrastructure - especially in dams and irrigation schemes:** - Agricultural and livestock development depends on the development of proper infrastructure—including dams, irrigation schemes, effective water harvesting practices, boreholes, spate irrigation schemes and water conservation technologies. These investments help improve productivity sustainably. Although some efforts are ongoing with water management, currently some of the approaches are not working well for various reasons, and others that are successful are not adequately scaled up. The availability of motor water pumps, good maintenance skills and dependable power supply (electricity and/or fuel) is crucial. The installation and maintenance of drainage networks is also important, as is the need to maintain or construct road networks for remote areas with problems of accessibility.

**Sensitization and capacity development:** - Creating greater awareness among producers and increasing the technical and physical capacity of extension workers is important for effective agricultural development in the drylands. Livestock and crop production requires intensive follow up, quick decision making according to the conditions and the use of early warning systems. Producers and extension workers are effective when they use traditional practices alongside scientific techniques. Physical capacity building is also essential with extension activities requiring facilities including motorbikes, cold storage, artificial insemination tools, animal health facilities, etc. Sustainably tends to be improved when private input suppliers and service providers are supported and encouraged to be involved in agricultural development activities.

### **Securing an adequate supply of inputs and services:**

- Mechanisms that provide required inputs and services on a sustainable basis help to address unnecessary input price inflation. Some technologies require time and resources to be able to multiply and supply, for example the supply of an adequate number of rams. There is a need for effective planning to create input supply and service delivery systems that are sustainable, affordable and timely.

**Provision of credit services:** - There are many controversial issues with regard to credit. According to producers, credit is essential to undertake activities in crop and livestock development, but the risks in taking on credit are always very high, particularly in the dry areas. The interest rates for loans are often within the range of 8 to 19 percent and there are no schemes or strategies designed to provide grants to producers or rescue them from complete failure. Investments by smallholders in irrigated agriculture (especially vegetables and fruits), fattening based on improved supplement feeds, poultry production and apiculture are all potentially successful options. They need to be supported however with the design of a good business plan that considers the availability of inputs/services and the market for their products. The introduction of appropriate insurance systems can facilitate the services of credit.

**Developing suitable crop genotypes:** - There are a limited number of crop varieties adapted specifically for dryland production systems, even though this is crucially important to give producers alternatives and options. Varieties with resistance to the biotic stresses (weeds, insects, pests and diseases) and abiotic stresses (drought, temperature, salinity, acidity, etc.) that prevail in the drylands, and species and crop varieties that fit with different cropping systems, are essential. The best technologies are those that support effective use of water and consider the water requirements of various crops, nutrient stresses, and the effective traditional drought coping strategies. All technologies once developed need to be demonstrated to dryland farmers.

**Identifying appropriate agronomy and crop physiology technologies:** - There is inadequate know-how on agronomic and physiologic methodologies for selecting drought resistant crops and drought resistance mechanisms for major crops at different phenological stages. There are however limited works developing versatile crop varieties which are drought tolerant during limited rainfall, and produce or give more yield in good seasons or when water is plentiful. It is important that researchers characterize and document the traditional agronomic practices that provide important drought coping strategies.

### **Increasing information on cropping systems and crop ecology:**

- Various types of cropping systems are used in the drylands as the means to minimize risks of complete crop failure. For example, multiple cropping was very common in the study area. With the introduction of different new crops, like fruits, vegetables and other perennial and annual crops, there is a need to look at how these crops are well integrated into the production system to maximize efficiency. This requires looking at the experiences of other countries and generating information through action research. It would be good practice to look into the following areas:

- Perennial leguminous tree species like fruits and their suitability for different cropping systems
- Appropriate cropping systems to reduce environmental degradation, improve soil fertility, reduce pest infestation and stabilize crop production
- Delineating potential areas appropriate for different cropping systems such as mono cropping, inter-cropping, double/single cropping, afforestation, grazing lands, enclosures, etc.
- Developing alternative crop species that can diversify the existing predominantly cereal based mono-cropping systems, and suitable to areas with problems like salinity, acidity etc.

**Use of proven livestock technologies:** - Agricultural technologies that showed the most success included: improved sheep breeds, dairy technologies in areas with markets, apiculture and poultry. But these technologies are highly constrained by the supply of the technologies and on-going services, for example the number of rams distributed per year is insignificant compared to the demand. To be successful AI services need to function well, and synchronization activities need to be supported with inputs and technicians. One option to supply these technologies more sustainably is to engage different partners including the private sector. The relatively good success story of improved poultry in many areas is a good example of the involvement of the private sector.

**Integrated pest management (IPM):** - Pests are major problems for crop production in Ethiopia's drylands, with, for example, striga and parthenium being serious weeds in maize and sorghum production. Several insect pests and diseases occur in grains and horticultural crops like tomato. Effective use of integrated pest management is a potential solution. Obtaining information on yield loss associated with major pests, epidemiology of pests, biological control agents, botanical plants, pesticide recommendations (rate, time and frequency), pest tolerant crop varieties, indigenous pest management strategies, and the impact of pesticides on the environment and other related things are very pertinent.

**Food science and post-harvest technology:** - Crop production for addressing nutrition and reducing the recurring issue of malnutrition is crucial and needs to look at high food value crops, effective post-harvest management and food science. Improved information on post-harvest losses of food crops and understanding the processing qualities of crops is important. For example, during the study farmers reported on the good quality of local sorghum varieties for making injera compared to the improved ones. Good practice involves identifying; appropriate food processing technologies (for households, cottage and agro-industries); information on storage conditions; shelf life of fresh and processed food products; and the impact of agro-chemical applications on the quality of products, etc. The introduction of livestock products like eggs and milk can tremendously improve nutrition, but producers need to be aware about their importance to family nutrition. Improvements to the utilization and management of crop and livestock by-products are also effective activities.

### **Market linkages and the introduction of processing and value addition schemes:**

- Effective marketing systems can help to minimize the impact of seasonal peak production on low prices, wastage of perishable products, and ensure a fair and sustainable supply of inputs. An overall analysis of the system and search for the best marketing alternatives is advisable, for example some products are processed and preserved but in terms of income producers lose out - currently fresh milk is paying more than if it is processed into butter and cheese. Among other best practices, the following are very relevant:

- Producers should be advised to produce strategically targeting the peak market time
- Producers should diversify their products so that competition among producers and over supply at certain times is minimized
- Strong market linkages established wherever there are feasible marketing options
- Value addition of products to increase income and extend the shelf life for extended periods of time
- Strengthening cooperatives to facilitate some of the above and to improve marketing. Cooperatives can also provide services in input supplies with reasonable prices, establish processing factories or encourage other investors to be engaged in the business and support the system.

## 4.3 Potential and opportunities available for the drylands

Even though the drylands are constrained by a range of challenges, there are also a number of opportunities that can help in better utilizing the resources available and improve the livelihoods of the drylands' fragile households. The potential and opportunities available for Ethiopia's drylands include:

### **Fresh water potential for irrigation and irrigation infrastructure:**

Even though one of the critical problems in most parts of the drylands is water shortage, there are also many parts of the drylands that are endowed with surface and groundwater potential that can be utilized for irrigation. There are fresh lakes, such as Lake Zeway and Koka in the rift valley drylands, and Lake Tana and Ashenge in the highland drylands. There are also rivers crossing the drylands that can be arrested for irrigation. At the same time there is also groundwater potential which can be reliably used for irrigation purposes: Raya plain in Wollo and Tigray Regions has been confirmed as having huge groundwater potential, and there are many other places in the drylands which are believed to have groundwater potential. It is also recognized that there are many potential sites in the drylands where catchment-based dams could be constructed at hill bottoms and in watersheds. There is also substantial potential in lower stream drylands for spate irrigation.

Irrigation farming in the drylands is often promoted as being the most dependable practice to improve livelihoods within a short period of time. The construction of different dams by the Government in many areas in the drylands for irrigated agriculture is seen as a good opportunity. The current market-oriented agricultural focus, especially for high value crops like vegetables and fruits, and livestock, is attracting investment by agricultural professionals to work under irrigation. The increasing demand for vegetables, fruits and grain crops, as well as a source for livestock food, both in the local and export market is a good opportunity for the drylands generally.

### **Knowledge of universities and research institutions:**

There are now universities graduating academics with increased knowledge of drylands at BSc and higher levels. There are also thousands of dryland graduates waiting for employment who can help address dryland agriculture issues on a more sustainable basis. The newly established universities across the nation will also provide opportunities to help more beneficiaries in the drylands in terms of research and development. Ethiopia has a considerable number of agricultural research institutions and centers that are devoted to generating technologies for dryland farming systems.

### **Experience of NGOs and Research and Development**

**partner organizations:** Apart from public /government interventions, there are large numbers of NGOs and special programs that are devoted to improving the livelihoods of dryland communities including: the Sustainable Land Management project, GIZ, Helvetas, Relief Society of Tigray, Organization for Rehabilitation and Development in Amhara and many others. These development partners have helped introduce new innovations such as bench terraces, roof water harvesting, composting with Effective Micro-organisms and many others. The innovative approaches and technologies introduced by NGOs and programs can potentially be scaled-up to larger areas of drylands across the country. In addition, international organizations such as CGIAR, FAO, UNDP, and the African Union Semi-arid Food Grain Research and Development program, as well as regional development organizations, private development companies, etc. could potentially leverage drylands development in the country.

### **Suitability of the drylands for the livestock sector:**

There are parts of the drylands that cannot be utilized for crop farming, but which are favorable for small-scale livestock production, such as sheep and goat rearing.

**Availability of biodiversity:** - In the drylands plant biodiversity is rich and highly diversified. Dryland areas are also the habitat of various types of plant and livestock species. Drylands across the world are the center of origin and diversity of many cultivated crops: sorghum, finger millet, field peas, chickpea, cowpea, perennial cotton, safflower, castor bean, sesame and others (Hailu and Kidane, 1991). These resources are important for improving crop production in the drought prone areas of Ethiopia.

# 5. CONCLUSIONS AND WAYS FORWARD

## 5.1 Conclusion

Various development efforts have introduced and disseminated many different types of agricultural technologies to the drylands, from both governmental and non-governmental partners. The technologies introduced cover crops, livestock and natural resources management.

Short season improved varieties of crops have been introduced to dryland farming systems, although the extent of their adoption and use is low and varies from one location to another. In drylands areas that have access to irrigation, the adoption of improved technologies—such as improved varieties of cereals, vegetables, fruits and others—has progressed well. On the other hand, in rain-fed parts of the drylands agricultural technology adoption and use appears to be very low, mainly due to frequent drought occurrences and the increasingly erratic nature of rainfall distribution, which can terminate early at the time of flowering and grain filling. As a result, even the short season improved varieties require supplementary moisture in the late growing season. Supplementary irrigation is therefore necessary if dryland households here are to increase their levels of crop technology adoption and improve their livelihoods.

Livestock population per household in the areas studied is reported to follow a declining trend over time due to frequent drought occurrence and consequent feed shortages. In response to human population pressure, cultivable land per household has also declined over time, encroaching onto grazing lands and therefore also reducing livestock population levels. This trend is evident especially in the highland drylands where farmland shortage is acute and human population density is high.

Natural resource management technologies, such as water harvesting structures, have been introduced and constructed especially in the severely drought prone drylands. However, only a few of the farmers have appeared to be beneficiaries. These technologies were either not appropriate, ineffective or were unaffordable to smallholder farmers.

Despite the many efforts, success stories in the various agricultural development interventions towards overall improvement of livelihoods in the drylands were found to be very limited. The major challenge hindering development is climate variability accompanied by the limited economic capacity of the community to invest in improved agriculture. This has resulted in limited use of inputs and households seeking continuous support in terms of emergency assistance, which has brought about attitudinal change and dependency syndrome.

It was also revealed that introduced technologies were often inadequate, fragmented, had no proper packaging, and at times had been developed without a needs assessment or checking of their appropriateness to the targeted localities. This has resulted in their poor adoption. The low level of awareness and skills of beneficiaries and extension workers in the introduced technologies has also contributed to the failures of implementation. Despite all this however, there are some encouraging achievements from the introduced technologies and from good practice adoption. These include crop production intensification under irrigation, the introduction of new crops like fruits, marketing systems improvements, fruit and tree nursery expansion, and the use of supplementary irrigation. Successful livestock technologies include dual-purpose poultry strains expansion, apiculture and fattening. Nonetheless, taking adopted technologies and good practice to scale is constrained by poor and untimely supply of inputs, like improved seeds, ineffective extension systems and poor marketing linkages.

## 5.2 Suggested intervention options and the way forward

There are many technologies available that could be scaled up and adopted by dryland farmers to increase crop production. Agricultural technologies include crop varieties, irrigation practices, moisture conservation, water harvesting and mechanization technologies; all of which are available to be introduced immediately and improved over time. Likewise, livestock technologies are available for immediate use and include improved



breeds for meat production (cattle, sheep and goats), suitable forage crops for the drylands, improved feed utilization and feeding practices, disease prevention and control, processing of animal products, etc. Technologies make it possible for dryland challenges to be addressed and the livelihoods of fragile households to be improved on a sustainable basis. A number of recommendations have been made in the preceding sections. The major and strategic intervention options are recommended as follows:

**Utilize available water potential and create access to irrigation:** If the major challenge of the drylands is moisture stress, a fundamental option is to create more access to moisture availability. All the potential water bodies available in drylands, as described above, should be adequately utilized by allocating sufficient resources to construct and install small-scale irrigation structures. In-depth hydrology and socio-economic studies need to be made in all the potential water bodies to estimate the potential areas of irrigable land for each of the water bodies, and to determine economic feasibility in relation to the number of beneficiaries. Any potential conflicts and unforeseen social matters also need to be figured out in the course of the study. Based on this, adequate resources should be allocated. Interventions should also be prioritized, such as to make a priority focus on arresting rivers and diverting lakes, followed by utilizing ground water, and then by constructing dams. This intervention, accompanied by the introduction and promotion of appropriate technologies, can sustainably help draw dryland households out from the vicious circle of poverty and enhance their resilience to climate change shocks. Dryland households can benefit from small-scale irrigation potential and sustainably improve their livelihoods—improving their food security and resilience to climate change, and potentially becoming market oriented commercial farmers opting for export.

**Introduce, promote and disseminate packages of technologies along the value chain and build strong partnership:** - It is well known that the extension programs of the Ministry of Agriculture and Livestock Resources are planned as packages, however in most dryland areas it was observed that the crop and livestock technologies introduced are rather fragmented. This could be for two main reasons: (1) technologies are demonstrated and disseminated as piecemeal and not as fully-fledged, which is usually due to lack of required inputs services and other physical capacities; and (2) actors are not working in a well-coordinated way with clear objectives. It is time to strengthen the demonstration and scaling up of technologies as packages, which could be achieved if there is a critical follow up and proper supply of inputs. The efforts of the different development actors

should also be coordinated to create synergy and for effectiveness.

Dryland challenges are intertwined and diverse, requiring the introduction and promotion of technologies as full packages to achieve sustainable impact. For instance, improved varieties should be accompanied not only with fertilizer, but also with pesticides, soil and water conservation structures, intensive capacity building, close monitoring and technical backstopping, market linkages, saving culture and other packages. Interventions should also be participatory involving not only the community but also partners across the value chain, such as Office of Agriculture, research institutions, input suppliers, processors, traders and others.

**Development of crop varieties that are tolerant/resistant to drought, heat, pest and diseases:**

Developing appropriate crop varieties for the drylands is not well emphasized in the national research system: The current practice is adapting crops that have been developed from other countries. To be effective varieties must be locally developed under Ethiopia's specific conditions. Ethiopia needs to build up its capacity to respond to emerging biotic stresses through networks of international contacts among the breeders, pathologists, entomologists and agronomists. The myth of local-variety superiority needs to be directly confronted.

**Promotion of grain legume and oil crops:** Public-sector intervention will be necessary for the expansion of the grain, legume and oil crops sector in the semi-arid areas of Ethiopia. The combined activities of introducing new production techniques and the identification of new export and/or domestic markets has been well demonstrated by the pigeon pea activities of the International Crops Research Institute in Semi-Arid Tropics (ICRISAT) in Kenya. Sesame and groundnut are economically important locally and have very good prospects for international markets. Therefore the introduction and generation of improved oil crop and pulse varieties, and production packages for irrigated and rain-fed areas, is important. It is also important to verify and scale-up high yielding and good quality varieties that are in the pipeline in the research system.

**Strengthen use of improved livestock technologies:**

There are different livestock production technologies that are suitable to drylands, and have very less impact on the environment when profitably engaged. As these technologies vary from place to place within the drylands it is necessary to identify the appropriate intervention based on a critical analysis of the situation. But generally the following are very pertinent interventions: fattening (cattle, sheep and goats);

poultry (mostly dual purpose, but layers or broilers are options); dairy (cross bred animals in per urban areas); apiculture (with improved and transitional hives); and feed and forage seed production. These technologies should be accompanied with improved feeding, health management and effective marketing systems.

#### **Utilization of crop physiology as a tool for yield**

**improvement:** Crop physiologists and breeders should work together in designing the architecture of plants and crops to optimize the production and partition of assimilates in space and time. Unfortunately there is currently very little effort in Ethiopia by physiologists to prove the potential benefits of crop physiology to improve crop productivity. More efforts are required by our crop physiologists to carry out extensive studies on crop growth and development aspects, partitioning of total dry matter production into different components particularly of economic interest, varietal differences in rooting patterns, plant water relations and drought tolerance, etc.

**Use of simulation models in the dryland areas:** Rain-fed crop production in the semi-arid areas is risky. This is mainly due to inadequate and highly variable rainfall. Thus, although broad generalization could be made from field experiments on the effect of management practices on crop growth, extrapolation of such results is limited by variation in rainfall, soil conditions and agronomic practice. The use of simulation models offers the prospect of enhancing the application of experimental results to other seasons, sites and management practices.

**Design dryland friendly extension approach:** The challenges and features in the drylands are different from other parts of the country. The extension approach, which is literally a 'one-fits-all approach', holds well in moisture surplus areas but does not hold true in drylands. Therefore, the drylands requires its own extension strategy that is friendly to dryland households and agro-ecologies. Agriculture professionals, experts and DAs need to be dryland agriculture graduates. There should also be special provision and incentives for DAs and agriculture experts who live in drylands with its inaccessibility, limited infrastructure facilities, inadequate public services and inconvenient conditions. The capacity of extension workers should be improved and must be accompanied with clear TORs and measurable results, with attractive incentive mechanisms. Along with this, there should also be a gender friendly extension approach that provides benefits to women, and youth as well, depending on their needs and priorities. Women based extension approach could focus on garden farming, fruits and vegetables, apiculture, poultry, dairy, processing and value addition. Youth oriented extension could focus

on apiculture, fattening, poultry, dairy and fruits and vegetable farming. There is a need to widely engage the private sector in the supply of inputs, provision of services and extension services, as this is a more sustainable approach.

#### **Establish infrastructural facilities and public**

**services in drylands:** There should at least be basic infrastructure in the drylands to support development interventions; for instance, transportation facilities and services, potable water supply, schools, electric power supply and mobile network coverage. It is with these facilities that other technologies can sustainably be made accessible to dryland households. Monitoring and regular support could also be provided reliably once these infrastructures are put in place. DAs, school teachers and other development actors can also settle in dryland areas, substantially reducing turnover if these facilities are available. Apart from this, these facilities can also create employment opportunities for youths and women in rural towns and villages; such as barbers, in metal and woodwork, transportation, fattening, petty trading (shops), local beverages and others. It also facilitates market linkages, enhances business orientation of small-holder farmers and attracts investment opportunities.

**Strengthen watershed-based dryland farming:** Soil and water conservation strategies and associated interventions can only be sustainable if they are preceded with watershed-based farming. A watershed approach should, however, be guided by scientific approaches rather than on a campaign basis. All actors that are required to develop watersheds should join hands and act in harmony rather than run individually in different directions. Technologies, public services, the community and others should integrate to make the watershed approach successful and sustainable. The current situation of land degradation, overgrazing, deforestation and erosion should be stopped and reclamation activities should be mobilized. In line with natural resource conservation, the entry points always needs to be water and soils as these are the mediums that crops and livestock are based on.

**Focus on long-term interventions rather than short-term benefits:** Interventions made so far were observed to have focused on short-term visions rather than on sustainability. Avoiding campaign-based interventions and establishing sustainable strategies can help draw dryland households out of poverty on long-term basis. Campaign based work has led to reporting and communication of exaggerated and distorted information to policy makers and other development partners. It is important to prioritize challenges and design short-term, medium-term and long-term interventions. Overall, developing a 20 to 25-year

program to transform and integrate the drylands and the 'degraded' areas in the 'highlands' with the rest of the country would be a better approach.

**Establish a reliable information exchange mechanism:**

Sharing and communicating distorted information leads to distorted planning and implementation, resulting in eventual failure. Therefore, bottom-up and top-down information sharing should be designed in a measurable and observable way. Reporting and communicating only the realistic information existing on the ground should inform all actors. There should be intensive awareness creation and capacity building on recording, documentation and reporting mechanisms. Evidence should be supported with figures, videos, sound recordings and other electronic methods and mass media. There should also be a mechanism for checking and confirming the reliability of information being communicated to policy makers and other partners. Everyone should be held accountable for the information and evidence he/she documents and communicates. At the outset, development planning should be preceded by realistic ground level information and evidence.

**Establish a sustainable recognition and motivation system:**

To maintain the pace of growth and improvement especially in drylands, there should be a system of recognition and motivation to the actors who excel in their performance. Motivation could be in various ways, such as promotion on mass media, certificate awards, material or financial awards. This can help to scale up best practices of successful farmers, institutions or individuals to fellow farmers, other institutions or colleagues.

**Focus on changing attitudes of dryland households:**

Substantial numbers of people in the drylands have developed a dependency syndrome associated with food aid and various government supports. Expectations are high that government should supply everything regularly free of charge. Because of this, households tend to shun facing challenges or determination for change. Therefore, any intervention should be preceded with awareness creation and consultation on the benefits and proposed approaches, and their contribution to long-term impacts on livelihoods. It is essential to indicate that interventions are helpful to HH to get them out of the vicious circle of poverty and so that they have the chance to own it.

**Introduce and strengthen a cluster-based and multi-stakeholder innovation platform approach for interventions:**

As has been started by Amhara and Tigray regions, and also piloted by the Agricultural Transformation Agency (ATA), the cluster approach appears to be helpful for farmers for various reasons.

It helps to focus targeting, facilitate access and dissemination of inputs, and more efficient use of resources. It is also convenient for establishing contractual farming and market linkages with processors, domestic traders and exporters. Therefore, this approach could also be applied for dryland farming. Clusters in drylands could be established either on a commodity or watershed basis, such as a maize cluster, sorghum cluster, dairy cluster, vegetable and fruit cluster, and others. A cluster approach could be accompanied by a multi-stakeholder innovation platform to bring all the actors along the value chain of a certain commodity onto a common platform, helping to identify and address challenges along the value chain.

**Institutional arrangement for the drylands:** For sustainable change in the drylands, it is important to start with institutional arrangements. There should be a separate body dedicated to addressing the challenges of the drylands. This body should be staffed with individuals with knowledge of dryland farming. It is important to assess the institutional approach, structure, capacity and strategies, and make sure the issues of the drylands are well addressed in the national research system. There should be research centers dedicated to conducting basic research and generating appropriate and long-lasting technologies for drylands that work closely with dryland institutions. There is a need to strengthen the number of qualified and skilled researchers in the regional research systems and especially in the drylands. Researchers should be those who graduated with drylands degrees.

Although several International Agricultural Research Centers (such as IFPRI, the World Bank, FAO and others), are working on policy issues related to food security in Africa, there is no coordinated network for policy research. University social science programs are not well linked to those of public-sector institutions, and they tend to be theoretical in content. There should also be an institution that facilitates financial support for dryland producers to access technologies. Research and extension should work closely and in harmony.

**Empowering agriculture offices of drylands:** All technologies and interventions are mainly channeled through the Office of Agriculture both at zonal and district levels. However, these offices are not adequately staffed or equipped with basic facilities, such as adequate budgets, field vehicles or motorbikes. Unless this problem is addressed on a sustainable basis, monitoring and closer technical support to dryland farmers cannot be made effectively. There are cases where one Department is allocated only 60,000 Birr as its annual operational budget and has no single computer. Inadequate recognition is also discouraging

and demotivating for office of agriculture staff. Therefore the focus should be made for dryland Offices of Agriculture to be staffed with the right professional mix and allocate adequate budgets to meet their basic operational costs.

Other suggested interventions

- **Farm implements:** Farm implements, such as hand driven motorized plows, should be promoted and made available to dryland farmers to enable them plow their land in time and complete early. This is because oxen are poorly fed in the dry season and become emaciated so their body condition is not able to plow effectively. This timely intervention would help to use available moisture properly at the right season, and should be piloted for selected groups of farmers with credit facilities arranged for them to purchase motorized plow. Cluster approaches should go along with use of mechanization tools.
- **Commercial farms:** Large-scale commercial farms should be evaluated against rigorous environmental impacts. The government should establish a critical control mechanism to protect against importation of banned chemicals, as these chemicals, discharged by commercial farmers, are causing pollution on lakes and rivers. One of the examples is Share Ethiopia Flower Company located at the town of Zeway, which is polluting Lake Zeway, and which is home for fish and a source of irrigation and drinking water. The spillway river from this lake (Bulbula River) is also a source of drinking water for animals and humans, and used as irrigation, and has also been badly polluted with chemicals.
- **Capacity building:** Most of the trainings being offered so far are not focused on problem solving and skill building. They are rarely based on a needs assessment and do not add significant skills to the trainees. Therefore there should be strategic planning of trainings based on need assessments. Trainees should also be categorized according to their skills, knowledge and backgrounds to help tailor problem solving trainings. Capacity building trainings are better organized at the time of commencing farming. But trainings should not be campaign based and in a rush, but based on need assessments and skill based with practical demonstrations.
- **Nutrition:** Focus should also be made on nutrition because dryland households that are affected by drought are easily exposed to diseases if they are not fed with nutritionally balanced foods. One of the options could be expanding quality protein maize varieties and poultry.
- **Credit access and saving:** Introducing and promoting a savings culture is essential in the drylands to help households save the scarce resources they obtain. Without this, all efforts will remain in vain and poverty will keep perpetuating, making a vicious circle. Dryland producers require lower interest rates for credit.
- **Market Linkage:** In areas where there is access to irrigation there is a need to establish market linkages to avoid supply glut and consequent price failure at harvesting season. There should also be processing factories to absorb all that supply. Farmers should be given adequate market information ahead of time to help them prepare.
- **Youth empowerment:** Organize the youth to engage in appropriate interventions in different areas, like fattening and sheep and goat rearing, in the drylands where there are extensive grazing lands. While the government gives direction for youth to engage in metal work, fattening, woodworking and dairy, youths instead prefer to be engaged in petty trading, shops, tailoring and supermarkets. Although government support for the youth should be in accordance with their interests, government direction should also be flexible and depending on the realities on the ground. The attitudes of youth should be also be changed, in that they expect change to happen overnight. They do not have endurance for projects that require a bit of time.
- **Family Planning:** Even in good years production cannot feed the rapidly growing population. Therefore interventions should also strengthen the family planning initiatives that are already in action.
- **Nursery development:** There is a need to establish central seed banks and a seedling-raising center in the regions for afforestation.
- **Demonstration and exhibitions:** When new technologies are introduced, they should be preceded with demonstration either on model farmers' plots or Farmer Training Centre (FTC) plots. It has also been strongly suggested that extension approaches are preferred when supported with practical demonstrations over video. Another suggestion is to organize farmer exhibitions (farmer festivals) where farmers display their produce and establish direct linkages with large-scale buyers without intermediary brokers. This provides a chance for farmers to get exposure to market information, such as prices, as well as quality standards and demand and supply status.
- **Address land shortage:** In most parts of the drylands in the country, cultivable land accounts for only a small proportion. For instance, in one of the districts in Tigray region it accounts for only 17%. The challenge now is how to make the remaining land more economically beneficial. One of the options could be mining, especially for youth, or providing land for youths and supporting them to engage in fattening, goat and sheep rearing, apiculture, etc.



- **Establish early warning system:** Early warning information for dryland farmers on weather forecasting can help them prepare for the type of crop variety they have to use.

The above-suggested interventions could help bring meaningful changes if they are prioritized according to need, and contextualized to the particular target group or locality. The interventions should be planned in a well-integrated way among the different sectors, actors and disciplines to create synergy and efficient use of resources. Involvement of the farmers and relevant actors along the value chain is crucial. A strong monitoring and evaluation plan need to be put in place to track changes. Interventions should complement and be aligned to ongoing efforts and activities. The suggested interventions could have a positive impact on the livelihoods of the community, the economy and the environment, which eventually helps to realize sustainable development.

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# ANNEXE 1

## Case Analyses of Dryland Farmers in Ethiopia

### 1. Example of how a Female Household Head is disadvantaged (Wukro, Kiha Kebele)

Mrs. Abraha is one of the widows in her kebele, which is a typical rainfed dryland. She is aged 40 and has faced tough times since she became a widow. She doesn't have the resources to generate sufficient income through sales or for engaging in petty trading, and consequently she had no choice other than from receiving food aid support through PSNP. She says, "Women (FHH) are the most disadvantaged households in our kebele compared to married women. This is because FHH are not benefiting out of their own land as they have to rent it out to other farmers and receive a meager share of 25%. As well as this, our farmland is not well managed and no NRM physical structures are built, whilst men's farmlands are protected". Therefore, Mrs Abraha requires supports to get oxen with credit. "Even though we got goat rearing support from an NGO, we sold them away to purchase food at times of drought." Interventions appear only to provide short-term benefits to Mrs Abraha. She also requires credit for petty trading and to engage in goat rearing and poultry.

### 2. Example of a successful youth moving into poultry production (Wukro, Agulae kebele)

Mr. Abraha Assefa, aged 26, is unmarried has attended grade 10th education. Following completion of his high school education, he got desperate and had no idea of how to shape his future career. He thought he would succeed if he migrated to an Arab country, and so he left for Saudi Arabia in 2010. Four years later, he came back to his home village. On his return he had no clue on how and where to invest his small savings. On one of the days the administration of his village called a meeting of unemployed youths and offered them land and support in whatever business they would like to engage in. He received a 550m<sup>2</sup> plot of land from the village administration and courageously decided to engage in poultry farming. He then constructed a poultry house and purchased 800 layers with Birr 120,000. He has also taken a loan of Birr 100,000 from Dedebit Micro-finance (MFI) for three years to strengthen his business. He now produces 550 eggs per day on average, and generates Birr 1650 gross income per day, which means an annual gross income of Birr 600,000 at a minimum. He has now become economically strong and plans to diversify his business.

### 3. Example from a group of elderly farmers on how the livestock population has declined over the years in the drylands

A FGD with elderly farmers was inspiring to learn how the current farming systems evolved over the years in the drylands in response to climate change and government policies. The trend in livestock population, which used to be the main stay of dryland livelihoods in earlier days, was discussed. The elderlies recalled that the hundreds of cattle, sheep and goats that a household used to keep has now ended, with people now either having a few (less than 10) or even none. Some of the factors that contributed to this were described by the elderlies as follows:

- In drylands farmers have lost their livestock population since the great drought of 1985 (1977 E.C), which displaced dryland households mainly to the Southern and Eastern part of Ethiopia with the massive villagization program. During this time the livestock population was severely affected by drought and others were sold away. Since then the livestock population couldn't be recovered to earlier days.
- In the mid 1990's, the time also came where households were forced to enroll every school age child into schools (these children had been supporting the family as herders). Because of this households sold and minimized their livestock population as there were no herders.
- Moreover, communal grazing lands and hills have become closure areas, in effect leaving no place to keep livestock. Elderly-dominated households are unable to harvest feed from closure areas as the youth are sent to schools. As a result, they cannot make a benefit out of the cut-and-carry practice of feed sourced from closure areas.
- While the cattle population has decreased on the one hand, poultry keeping is becoming more popular in some parts of the drylands, though it couldn't always expand as desired due to feed shortage. Their feed being grain, farmers are unable to feed the chickens grain as there is scarcely even enough for food. Goat rearing is happening, but it also requires herding.

- Climate change (more frequent occurrence of drought) and human population pressure (and consequent shrinkage of grazing lands) have also exacerbated feed shortages and contributed to a decrease in livestock population.

#### **4. Example of a successful farmer using an open-well water-harvesting structure**

Mr. Ayalew Molla, aged 45, attended 6th grade education in earlier days and lives with a family of eight from Kobo Mendefera kebele. Recognizing the challenges of dryland farming, he has been looking for options for generating income. As the first attempt he produced rain-fed vegetables and generated Birr 5000 from sales. This experience gave him a clue that if he can establish a source of supplementary irrigation he could make better benefits. Therefore he decided to construct a water harvesting structure using geo-membrane as plastic cover of the well (it contains 89m<sup>2</sup> volume of water). Fortunately, he also received training on fruit production practices, after which he raised fruit seedlings and established an orchard in his garden. He planted various types of trees including mango, orange, coffee, avocado, lemon and hops. He generates Birr 13000 per year, from which he meets the cash demands of his family and purchases grain at times of food shortages. Apart from this, he also provides advice and technical inputs to fellow farmers, as a result of which they have established their own orchards. In the future he is planning to build a water harvesting structure with a concrete wall and expand his orchard for better income and impacts.

#### **5. Example of a successful farmer using a closed-well water harvesting structure**

Mr. Mekonnen Haile, aged 61, lives in Mendefera kebele of Kobo district, which is characterized by typical rain-fed dryland with an altitude of 1500masl. He is not literate and lives with a family of seven. He doesn't own livestock as he has sold them at times of drought to purchase food and pay for health services. "In late 1990's, with advise of a DA, I was lucky to be one of the farmers selected to host a water harvesting structure called a 'Dome', whose opening is closed, so no evaporation and it contains a lot of water (120m<sup>2</sup>). I used the water to raise fruit seedlings, and also sometimes for drinking through boiling. I raised fruit trees in my garden and established a mini orchard using the water stored in the well. I get a minimum income of Birr 2000 per year as well as for home consumption. After about 4 years of service, however the well got cracked and no longer contains water." Mr Mekonnen could not afford to get good maintenance for his dome. Fortunately his perennial fruits are already well established and can withstand water stress until they receive supplementary moisture from rain for about two months. Mr. Mekonnen is still generating income, with which he purchases food for his family at times of food shortage. He is also able to meet household cash demands from this income and minimize effects of poverty. In the future, he is planning to get services for good maintenance and to expand the orchard to generate more income.

#### **6. An example of a polluted lake and river**

Lake Zeway is one of the water bodies in the rift valley. Millions of the urban and rural population are dependent on it as a source of drinking water for both humans and animals. It is also a source of irrigation water for thousands of farming households living around the lake. There is a natural spill-way river named Bulbula, which is being used for irrigation, and human and animals drink both upstream and downstream. People have been making a living out of the lake and the river for the last 2 – 3 decades, however since the establishment of Share Ethiopia Flower Company and its release of chemicals directly into the lake and the river without undertaking any treatment, the life and health of the public and livestock have started deteriorating. According to community members, mothers have started giving birth to disabled children and because of this many of the women are refraining from becoming pregnant. Animals are facing the same problem and not improving their body condition during fattening. Instead they become emaciated and their skin gets full of sores. Vegetables that are mainly supplied to big markets are produced with polluted water from irrigation and are becoming risky for health. Even though the households make frequent appeals to the district and zonal administration, there is not yet a solution and future livelihoods are at a high risk of deterioration and crisis.

#### **7: An example of a successful youth in Oromia Region**

Mr. Hussien Abo lives in Bochesa kebele of Adami Tulu Jido Kombolcha district. Aged 35, he was able to attend only until a 6th grade education in the school located in his village. To proceed with his education he had to go to another town, but couldn't make it due to the poor economic status of his parents. Consequently, he discontinued his education and started to engage himself in fishing from Lake Zeway located in close proximity. He was able to generate about 200 Birr from sale of fish, with which he purchased a breeding sheep. Along with fishing, he then started generating supplementary income from the sale of ewes. He began saving what he generated from various sources, and with the savings he rented 0.25 ha of land for 600 Birr per year and a motor pump for 1200 Birr for four months. He started growing cabbages in the first year and generated an income of 3000 Birr. In the second year he turned to onion production and generated 6000 Birr. In the third year, he changed the crop to tomato production and



generated 7000 Birr. Since then, he started renting more land and has enhanced his annual earnings. He now owns vehicles and houses for rent from which he earns more income. Overall, the lesson he would share with others is that saving is the key factor for success, followed by hard work and determination to face challenges and aspiring for growth. He also recognizes that anyone should start work by generating a small income. Mr. Hussien did not own a single plot of land, but he overcame this challenge through generating money from other sources and renting land.

#### **8. Example of FHH to show how she became model farmer in Oromia Region**

Fatuma Nuna is aged 40 and a widow. She is illiterate and lives with nine household members. Following the passing away of her husband, she faced a big challenge to make a living for herself and her children. Even though she never did it before, she started plowing her plot of land despite it not being a common practice in her locality. She started working hard and maintained her commitment to meet the food demands of her children and to send them to schools. In her locality she saw a farmer who was recognized as "model" because of his dedication for change and working hard. "Since then my thoughts started to change and I convinced myself to work hard and improve my life". One day an NGO named IDE came to her village to support destitute women and picked her name to be a member of their beneficiaries. Since then she received many trainings on improved agricultural practices and associated skills. The most noticeable experience which changed her life is saving. She saves whatsoever she gets and produces. She keeps her produce and sells it when prices improve. As her small savings started to grow she thought of engaging in irrigation farming using the river in her proximity. She bought small-scale motor pump and started producing vegetables, such as green pepper. She also owns two milking cows and sells butter and cheese. As her children grew up they started supporting their mother and their life improved over time. The impacts included changing their house from grass roofed to corrugated roofed, being able to produce adequate food for year-round consumption, and being able to afford to send all her children to school. She owns her own bore-well pipe water with the support of an NGO as she became a model woman in the community. She also owns a TV and aspires to make many improvements in the future. Above all, she said "my attitude has been changed and demonstrates how individual commitment can bring changes to life". She also added "the reason other women have not improved their life is because of lack of commitment for change". The problem she faced was an inability to get access to medium scale credit to expand her dairy and irrigated farming. "The lesson I want to share with others is that saving, determination for change, efficient use of time, and making appropriate plans are the best practices that lead to livelihood improvements."

#### **9. Example of a successful MHH in diversified commercial farming**

Haji Abu Kawo is aged 66, attended only until grade 2 and lives with a family of 8 in Bochesa kebele of Adami Tulu Jido Kombolcha district of Oromia region. When he was a child he lost his father, who had been the support for the whole family. He discontinued his education and started plowing at the age of 10 on the family plots. He purchased maize when prices were lower and sold them back when the prices rose. He was also employed as a driver of a horse cart and also engaged in fishing to generate supplementary incomes. In all the activities, he saved his earnings in the bank. He then purchased a motor pump and began producing vegetables with irrigation. He was almost the pioneer in his village in starting irrigation based farming. He received advice from agriculture experts on farming practices. Irrigation based vegetable production has substantially changed the life of Mr. Haji. At the time of this study, he currently owns 5ha of land and rented in another 5ha, undertaking vegetable production on his 10ha of land. He also owns about 20 cattle, out of which six of them are crossbred cows. He uses 7 motor pumps for irrigation. He has constructed one house for himself and three houses for renting. He also owns one ISUZU truck and one motor cycle. Overall he has created lots of assets. The lesson he shares for others is "attitudinal change is required and everyone should face challenges and demonstrate commitment for growth. Saving is fundamental for improvement and everyone should engage in diversified businesses that bring even small incomes. There should be a sense of strengthened work culture. Nowadays, most of the youths dislike challenging jobs and if so, they cannot grow forever."

#### **10. Example of a successful youth in fruit farming (Kobo)**

Mr. Deribe Abate, aged 41, attended primary education (until 6th grade) and lives with a family of six. He owns 0.75 ha of land where he has been growing an improved pioneer maize variety with furrow irrigation. He got 6000 Birr from the sale of maize. One day he came across one of the village youth who had been growing a fruit (papaya) and making substantial income. Since then he got advice from this villager on how to grow fruits and started planting fruits the next season with irrigation. He obtained more than 21,000 Birr in income. With this money he rented 0.125ha of land and established a fruit nursery the subsequent year, from where he now expects more than 60,000 Birr. In future years he is expecting more than 100,000 Birr annual income from both the nursery and orchard. Mr. Deribe, has demonstrated his commitment to get out of poverty and his vision is to buy a truck and expand his income sources further. The lesson he wants to share for his peers and other youths is determination, saving and hard work.

### **11. Example of a successful youth in diversified farming (Kobo)**

One of the youths who has been successful in farming is Mr. Ayalew Yayu, aged 42 who attended until 10th grade education. He lives with a family of eight. He owns 1ha of land and rents another 0.75ha of land where he has been growing cereals with irrigation. When he was visiting markets, he used to see that the prices of fruits were far higher than cereals, so he sparked an idea of growing fruits and vegetables (onion, pepper) instead of cereals in subsequent seasons. He received seedlings through Office of Agriculture support and established an orchard of fruits (mango, hops, watermelon, avocado, etc.). In the first year, he generated an income of Birr 17,000 and this income doubled in the second year. In the following season, he noticed the demand for fruit seedlings and established a nursery of fruit seedlings, from where he got 140,000 Birr net income. The total annual income from his fruits and fruit seedlings now exceeds 300,000 Birr. He has also diversified his income sources by establishing a poultry farm where he purchases day old chicks and sells 45 day old chicks. He generates 180,000 Birr net annual income from the poultry farm. It is evident that Mr. Ayalew has demonstrated an amazing growth within the last ten years. He has constructed a house in Kobo town and also purchased a motor cycle. He has brought significant impact to his livelihoods in the kebele, which is characterized as one of the drylands. The factors that contributed to this growth are having access to irrigation, his innovativeness to diversify his income sources, strong saving practices, commitment, and entrepreneurship skills. In the future he is planning to become a large-scale distributor of fruit seedlings and install a fruit processing plant. When he is asked to provide advice for his peers and other youths, he strongly urges them to adopt a strong saving culture, a positive attitude for change and determination to face challenges, work hard and get out of poverty.

### **12. Example of a successful youth in vegetable production (Wukro, Genfel kebele)**

Mr. Daniel from Genfel kebele of Kiltie Awlalo district is aged 27 and lives with a family of four. He completed his high school education (12th grade). He then joined a youths association engaged in selling and and got some money. With this he started investing in his 0.25ha family plot and produced onions with irrigation, getting a 60,000 Birr gross income. In subsequent seasons, he bought his own motor pump and rented another 0.25ha to expand his onion production. From a total of 0.5ha of land, he obtained a total of 180,000 Birr net income. He is also engaged in apiculture (owns 8 modern beehives) that generates about 60,000 Birr per annum. With this, he has created significant livelihood impacts: he bought two oxen, constructed a house, purchased 6 motor pumps and is able to meet family cash demands. In the future he is planning to engage in dairy (purchasing 10 crossbred cows) and expand his irrigated farming by renting more irrigable land. Since the area has a potential for honey production, he is also planning to expand his apiculture to 100 modern beehives, where he can generate about 750,000 Birr gross income from the sale of honey. The major problem he is facing is market linkage for onion, as he could not get sustainable demand. When a supply glut occurs it results in a price fall. The lesson he got from his success is determination to face challenges and business-minded thinking to look for options and diversified income sources. He advises his peers to face any hardship with courage and engage on any business with dedication. "They should also look around for options of engagement".

### **13. Example of a successful MHH in income diversification (Wukro, Agulae kebele)**

Kes G/Meske Kibatu, aged 44, lives with a family of nine. He attended religious education and he is priest. He used to produce grain with rain-fed farming, where he was almost unable to produce adequate food due to moisture stress. As a result he started looking for options and decided to rent irrigable land and produce cash crops, such as vegetables. In 2010, he got credit of 5000 Birr and purchased one motor pump and rented 0.5ha of irrigable land to start growing vegetables with irrigation. In first year he got 9000 Birr net income. With this, he got motivated and rented an additional 1.25ha of irrigable land, where he started producing twice or three times a year of both cereals and vegetables (tomato, maize, onion, pepper, tef and wheat). Out of all this, he is getting about 600,000 Birr gross income from sales per year as well as home consumption. He has also brought one tractor to plow his land and generate about 90,000 Birr income from renting it. He is also engaged in apiculture and dairy production. Out of all these activities, he makes more than a million birr per annum. This has brought significant impacts on his livelihoods; for instance, he has constructed a house in the town and constructed a building along main road in the town from where he is generating income from renting. He shares the lessons for his success as, "Someone has to look for options of survival at time of challenges and remain dedicated. There is also a need to build business thinking spirit and diversify income sources".

