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Amhara Agricultural Research Institute

(ARARI)

Debre Birhan Agricultural Research Center

PARTICIPATORY AGRICULTURAL PRODUCTION SYSTEM ANALYSIS: IMPLICATION FOR RESEARCH AND DEVELOPMENT INTERVENTION IN NORTH SHEWA ZONE

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PARTICIPATORY AGRICULTURAL PRODUCTION SYSTEM ANALYSIS: IMPLICATION FOR RESEARCH AND DEVELOPMENT INTERVENTION IN NORTH SHEWA ZONE

Research Report No. 1

AGP-II PROGRAM SUPPORTED STUDY

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Amhara Agricultural Research Institute
AGRICULTURAL GROWTH PROGRAM

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ACRONYMS

AGP	Agricultural Growth Program
AI	Artificial Insemination
ARC	Adet Research Center
AWM	Agricultural Water Management
BoA	Bureau of Agriculture
CBE	Commercial Bank of Ethiopia
CCF	Christian Child Fund
CCPP	Contagious Caprin Ploro Pneumonia
CLPP	Community Level Participatory Planning
CSA	Central Statistical Authority
DBARC	Debre Brihan Agricultural Research Center
DPs	Development Partners
DZARC	Debre Zeit Agricultural Research Center
EAAP	East Africa Agricultural Productivity Project
GDP	Gross Domestic Product
KARC	Kulumsa Agricultural Research Center
MARC	Melkasa Agricultural Research Center
MoA	Ministry of Agriculture
MoWR	Ministry of Water Resources
NGO	Non-Governmental Organization
PPR	Pestides Pitites Ruminants
SARC	Srinka Agricultural Research Center
SLM	Sustainable Land Management
SWM	Soil and Water Management

EXECUTIVE SUMMARY

North Shewa is inhabited by rural agricultural households on an area of agricultural land consisting of arable and unarable lands. Out of the 24 Woredas 8 are identified to be AGP-II supported Woredas namely: Tarimaber, Kewet, Efratanagidim, Ant-sokiagemiza, Bassonawerana, Minjarshenkora, Moretinajiru and Siyadebirnawayu-Woredas. This research program was initiated as a component of the AGP research supported activities.

The purpose of this research is to analyze the production system using participatory approach and produce localized production constraints and potential from the Zonal to the selected woreda level. This research document includes woreda-level major production constraints and potential for major crops grown in the areas. Given the large scale of the survey and its use of a consistent methodology, we used data collected in 2016. In addition, we used CSA 2016 baseline survey data to verify our findings.

This research will provide a more opinion, finer view of where production is taking place given the relative diversity of production within the Zone. Hence, this study is expected to fill the knowledge gap by providing important insights into the nature of agricultural constraints and exploring production potentials. Hence, policy makers at federal and regional states in the farming systems, the agricultural and rural development agents, nongovernmental organizations, private agricultural investors, researchers and the sample woredas can benefit from the results of this study.

This paper is divided into three sections. Section 1 presents introduction part. Section 2 provides a detailed description of the data used for the analysis and the methods used for the estimations. Section 3 presents the results of socioeconomic, crop production and managements, livestock production and managements and natural resource and managements. For all disciplines prioritized problems, proposed areas for further research and recommendations are presented in each part.

1. INTRODUCTION

In Ethiopia agriculture is a dominant sector with crucial importance in economic growth, food security and poverty alleviation. It accounts for 85% of employment, and contributes about 36.7% of GDP and 85% of all exports (CBE, 2016). Ethiopia owns 55.0 million cattle, 27.3 million sheep, 28.2 million goats, 1.1 million camels, 51.3 million poultry and 5 million beehives (CSA, 2014). The livestock sector contributes 19% of the GDP and 16 to19 % of the foreign exchange earnings of the country (MOA, 2012).

The productivity of crops and livestock is below the world's average and its potential. This is due to lack of access to improved varieties of crops and livestock breeds, lack of improved management systems and different disease out breaks. The government has shown a strong commitment to enhance the productivity of the sector by allocating more than 15 percent of the total budget and working along with development partners (DPs). Significant portion of this budget and development interventions directly target the large chronically food-insecure population. Success requires complementary efforts to enhance agricultural growth, thereby reduce food prices and diversify rural livelihoods.

Over the last five decades, researchers and extension personnel have put much effort to generate and deliver improved agricultural production technologies to the farmers. Despite the development of several technologies, the conventional agricultural research and innovation endeavors persuaded in the past have not been very successful to deliver appropriate technologies to the end users. As a result, technologies were developed and adopted by the end users but considerable numbers of technologies are out of production without significant contribution to the objectives intended due to several factors.

The technology generated in this way might not address the real problems of the farming community as they were not demand driven and hence the farming community would be passive recipient of the new technology. The selected woredas for Agricultural Growth Program, named here after as AGP-II intervention woredas are potential for crop and livestock production. The majority or the lion share of zonal production is coming from these woredas. AGP II is aligned with the second five years growth and transformation plan. The program is aimed at achieveing a greater improvement in agricultural production and productivity through targeted supports and interventions in high potential areas of the region.

To enhance agricultural productivity, availability of improved technologies and information based on the technological need assessments is critical. Limited availability of agricultural technologies, inadequate capacity in multiplying source technologies and limited on-farm pre-extension demonstration of technologies are key problems hindering the availability of technologies to small scale farmers. The agricultural research component of AGP-II focuses on needs assessment to identify organizational capacity gaps and agricultural production constraints.

Accordingly, this assessment on agricultural production constraint was done with the objective of collecting agricultural production constraints. The study was conducted by the team of researchers composed of socioeconomics, crop, livestock and natural resource management research disciplines. The woreda level groups of the technical committee were composed of different institutions which

help to access valuable information from different directions. Therefore, this report is presenting the results of the assessment done in May 2016 in eight AGP-II woredas. The need assessment activities focused on identification of agricultural production constraints at woreda level which will serve as a basis for planning research activities to be implemented by different researchers in different disciplines and other practitioners. This study was conducted to evaluate the major agricultural production systems and identify major production constraints in the AGP II *woredas* of North Shewa Zone in Amhara Region. Furthermore, to describe and understand the farming system, to assess and describe the major agricultural constraints and to identify different intervention options for production improvement in AGP woredas and similar areas.

2. METHODOLOGY

2.1. Area Description

The study was conducted in North Shewa zone of Amhara Region. North Shewa Zone is bordered to the east with Afar, to the north South Wello and Oromiya Zones, to the west South Wello Zone and to the south Oromiya Region. In this study, eight AGP II *woredas* were selected and addressed. According to 2015 production season, the woredas have different production practices of crop, livestock and natural resource management. Different agro ecologies of high land, mid land and low land areas have faced with different production constraints. Agriculture is the major sources of income in the woredas (Appendex 1).

Antsokiya Gemza: is one of the *woredas* of North Shewa Zone in Amhara Region, Ethiopia. This *Woreda* is bordered to the south by Efratanagidim, to the southwest by Menzgera, to the west by Gesherabel, and to the north and east by the Oromiya Zone. The administrative center is Mekoy; other town in the *woreda* is Majete, which was the former town of the *woreda*.

Efratanagidim: is the second *woreda* found in the same zone. It is named after two historic *woredas* that were part of the former autonomous kingdom of Shewa, Eferata and Gedem. Part of the woreda is bordered to the south by Kewet, to the southwest by Menz Mama, to the west by Menz Gera, to the north by Antsokiya Gemza, and to the east by the Oromiya Zone. The administrative center of this *woreda* is Ataye formerly named as Effeson. Other towns in the woreda include Jewha and Karakore.

Kewet: is the third *woreda* in the Zone selected for this study. Currently Kewet is bordered to the southwest by Taremaber, to the northwest by Menz Mama, to the north by Efratanagidim, and to the east by Afar region. The major town of Kewet is Shewarobit.

Tarmaber: is located at the eastern edge of the Ethiopian highlands in Amhara Region of North Shewa Zone and it is bordered to the south by Ankober, to the southwest by Bassonawerana, to the west by Mojananwedera, to the northwest by Menz Mama, to the northeast by Kewet woreda and to the southeast by Afar region. The capital town of the woreda is Debiresina. Other small town includes Mezezo.

Bassowerana: is located at the eastern edge of the Ethiopian highlands and bordered to the south by Angolelanatera *woreda*, to the southwest by the Oromiya Region, to the west by Siyadebirnawayu, to the northwest by Moretinajiru, to the north by Mojanawedera, to the northeast by Tarmaber, and to the east by Ankober. The town of the woreda is the zonal town named Debre Birhan. There are other small towns in the woreda Keyit, Gudoberet and Goshebado.

Siyadebirnawayu: is bordered to the south by Oromiya region, to the west by Ensaro, to the north by Moretinajiru, and to the east by Bassonawerana. The administrative center is Deneba. Other towns in the woreda include Siyadebir and Wayu.

Moretinajiru: is surrounded by the Jemma river and the *woreda* is bordered to the south by Siyadebirnawayu, to the south west by Ensaro, to the northwest by Merhabete, to the northeast by Menz Keya, and to the east by Bassonawerana. The administrative center of the *woreda* is Enewarie and other small town found in the woreda is Jihur.

Minjarshenkora: is one of the eight *woredas* for the study and located at the southern end of the Zone and it is bordered to the east, south and west by Oromiya Region, to the northwest by Hageremariam-kesem and to the northeast by Berehet *Woredas*. Germama or Kesem River is the boundary for the three *woredas* of Minjarshenkora, Hageremariyam, kesem and Berehet. The administrative center of the *woreda* is Balchi. Other towns in the woreda include Arertie and Erabutie. This *woreda* is served by the Addis Ababa- Djibouti Railway at Malka Jilo station.

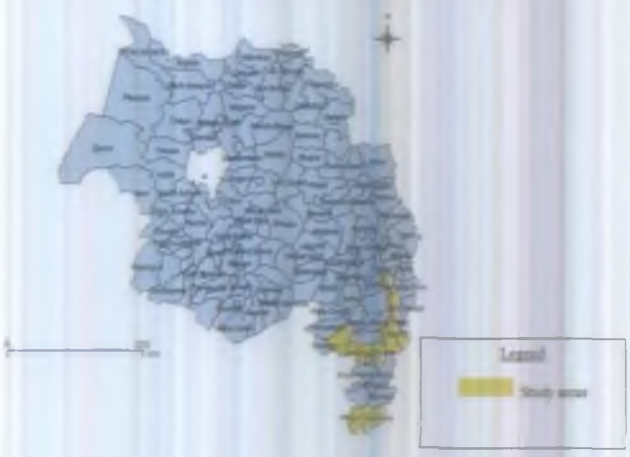

Figure 1.Study areas

2.2. Methods of Data Collection

Data collection method followed was group discussion and the sources of data were primary and secondary sources of the respected woreda. Woreda technical group from each woreda identified the problems from each *kebele* using Community Level Participatory Planning (CLPP) techniques. From each *woreda the* technical committee was invited by the coordinator and each representatives of each discipline/sector presented their findings. During group discussions the identified problems of crop, livestock, natural resource management and socioeconomic constraints were presented by the technical team. Problems already solved by previous research studies and available technologies were forwarded to the team. In particular, secondary data were collected from different disciplines of crop production, livestock production, natural resource management and other institutions. Each secondary data was organized from each representative disciplines by the team and organized as a single document and shared to the team for further analysis.

2.3. Data analysis

The core data collected from the selected *woredas* was analyzed using qualitative and descriptive statistics methods.

3. RESULTS AND DISCUSSIONS

3.1. Socio-Economic Characteristics of the Study Woredas

3.1.1. Farming system characterization

The result of the study for each woreda is written for each subtitle. The *woredas* are listed arbitrarily and the numbers indicate only the list of *woredas* not interest or priority. Each *woreda* is equally considered depending on the capacity of the research center. The result of the study was elaborated for each study woreda as follows:-

Antsokia Gemza: the production system is implemented using rain fed and irrigation water sources. In rain fed agriculture, the farmers mainly produce field crops of cereal and pulses, while using irrigation majority of them produce onion, tomato and pepper. The major cereal crops grown in the woreda are sorghum, tef, barley, wheat and maize. The most produced pulse crops are faba bean, field pea, chickpea, mung bean and haricot bean. Only sesame is produced from oil crops. The most common horticultural crops produced in the area are onion, cabbage, tomato, pepper, banana and mango. The available water sources for irrigation are underground water, rivers and streams. The livestock reared in the woreda include cattle, shoat, equine and poultry. The most common livestock feed sources are grazing and crop residues. In most parts of the area, livestock is reared for the purpose of food security and income sources. The area has regular rain fall distribution with an average of 800mm per annum. The main natural resources found in the *woreda* are natural shrubs, acacia and eucalyptus.

Efratanagidim: the production system here is implemented using rain fed and irrigation water sources. This area sometimes has bimodal rain fall main season and short season. In rain fed agriculture, the farmers mainly produce field crops of cereals and pulses. In the main season (rain fed agriculture) farmers produce long matured crops while in the short rainy season (*belig* season) farmers usually produce short matured crops. Sometimes during moisture shortage, long matured crops are produced using irrigation supplement. By using irrigation, the majority of farmers produce onion, cabbage, tomato and pepper. The major cereal crops grown in the main season are sorghum, tef, barley and wheat. Tef and green pod corn also grown in the short season rain fed agriculture. Mung bean is mostly grown in the short rainy season, which is the most produced pulse crop in the area. The oil crops produced in the area are sesame, sunflower and nuge.

The most common horticultural crops produced in the area are onion, tomato, cabbage, banana, mango and avocado. The available water sources for irrigation are mainly natural stream, rivers and some parts underground water. The livestock reared in the woreda include cattle, shoat, equine and poultry. The popular feed sources are natural pasture (grazing) and crop residue. In most part of the area livestock is reared for the purpose of security and income sources. The area has irregular/erratic rain

fall distribution with an average of 1018mm per annum. The main natural resources found in the *woreda* are natural shrubs, acacia and eucalyptus.

Kewet: the production system here depends on rain and irrigation water sources. This area sometimes has bimodal rain fall i.e. main season and short season. In rain fed agriculture the farmers mainly produce field crops of cereals and pulses. In the main season rain fed agriculture farmers produce long matured crops and in the short season (*belig* season) they usually produce short matured crops. Using irrigation the majority of farmers produce onion, cabbage, tomato and pepper. The major cereal crops grown in the main season are sorghum, tef, barley and wheat. Tef and green pod corn are also grown in the short season rain fed agriculture. Mung bean is mostly grown in the short season. The most produced pulse crops are mung bean, faba bean, field pea, lentil, chickpea and haricot bean. The oil crops produced in the area are sesame, sunflower nuge and linseed. The most common horticultural crops produced in the area are onion, tomato, cabbage, banana, mango and avocado. The available water sources for irrigation are mainly natural stream, rivers and some parts of underground water. The livestock reared in the *woreda* include cattle, shoat and equine. The available feed sources for the area are natural pasture (grazing), crop residue, hay and commercial feed industrial by-products. In most part of the area livestock is reared for the purpose of security and income. The area has erratic rain fall distribution with an average of 750mm per annum. The main natural resources found in the *woreda* are natural shrubs, acacia and eucalyptus.

Tarmaber: the production system in the woreda depends on both rain fed and irrigation water sources. This area has bimodal rain fall of main season and short season. In rain fed agriculture the farmers mainly produce field crops of cereals and pulses. In the main season rain fed agriculture farmers produce long matured crops and in the short season (*belig* season) farmers usually produce short matured crops of barley, mung bean and tef. By using irrigation the majority of farmers produce onion, cabbage, tomato and pepper. The major cereal crops grown in the main season are sorghum, tef, barley and wheat. Tef, barley and mung bean are produced in both short and main season rain fed agriculture. Mung bean is mostly grown in the short season.

The oil crops produced in the area are sesame and linseed. The most common horticultural crops produced in the area are highland fruits, papaya, banana, mango, avocado, onion, tomato, cabbage and garlic. The available water sources for irrigation are mainly natural stream, rivers and some parts underground water. The feed sources of livestock in the area are grazing of natural pasture, hay, crop residue, tree lucerne, oat and vetch. In most parts of the area livestock are reared for the purpose of security and income sources. The area has regular rain fall distribution with an average of 1250mm per annum. The main natural resources found in the *woreda* are natural shrubs, acacia and eucalyptus.

Bassonawerana: the production system of the woreda depends on both rain fed and irrigation water sources. This area has bimodal rain fall of main season and short season. In rain fed agriculture the farmers mainly produce field crops of cereals and pulses. In the main season rain fed agriculture farmers produce long matured crops of wheat, barley, faba bean and tef while in the short season (*belig* season) they usually produce short matured crops of barley and mung bean. By using irrigation water sources, the majority of farmers produce carrot, potato and cabbage. The major cereal crops

grown in the main season are tef, barley, wheat and sorghum. Barley and mung bean are produced in both short and main season rain fed agriculture. In some water logged areas farmers produce lentil using residual moisture. Mung bean is mostly grown in the short season.

The oil crop produced in the area is linseed. The most common horticultural crops produced in the area are garlic, highland fruits, carrot, potato, shallot, tomato and cabbage. The available water sources for irrigation are mainly river water, natural stream, and some parts underground water. The livestock reared in the woreda include cattle, shoat, equine and poultry. The available feed sources are grazing, hay, crop residue, tre lucerne, phalaris, industrial bi-products, oat and vetch. In most parts of the area livestock is reared for the purpose of security and income sources. The area has regular rain fall distribution with an average of 960mm per annum. The main natural resources found in the woreda are eucalyptus, natural shrubs, fodder trees and acacia.

Siyadebirnawayu: the farming system in this area is characterized by crop livestock mixed farming system. It has an annual production system in the main season only. Crop and livestock are more interdependent. There are also irrigation water sources from rivers and streams. In rain fed agriculture the farmers mainly produce field crops of cereals and pulses. In the rain fed agriculture farmers produce long matured crops of wheat, tef, lentil, chickpea, faba bean and barley. By using irrigation water sources, the majority of them produced carrot, potato and cabbage. The major cereal crops grown in the main season are tef and wheat.

The oil crops produced in the area is linseed. The most common horticultural crops produced in the area are garlic, carrot, potato, shallot, tomato and cabbage. The available water sources for irrigation are mainly river water, natural stream, and some parts underground water. The livestock reared in the woreda include cattle, shoat, equine and poultry. The feed sources of livestock are grazing, hay, crop residue, vetch, oat and industrial by-products. In most parts of the area livestock are reared for the purpose of security and income sources. The area has regular rain fall distribution with an average of 1247.5mm per annum. The main natural resources found in the woreda are eucalyptus, natural shrubs, fodder trees and acacia.

Moretinajiru: This area is characterized by crop livestock mixed farming system. It has an annual production system in the main season only. Crop and livestock are interdependent. There is also an irrigation water source from rivers and streams. In rain fed agriculture, the farmers mainly produce field crops of cereals and pulses. In the rain fed agriculture farmers produce long matured crops of wheat, tef, lentil, chickpea, faba bean, sorghum and mung bean. By using irrigation water sources, the majority of them produce onion, garlic, carrot, potato and cabbage.

The major cereal crops grown in the main season are tef, sorghum and wheat and that of pulse crops are lentil, mung bean, chickpea and faba bean.The oil crops produced in the area are sesame and linseed. The most common horticultural crops produced in the area are orange, mango, lemon, garlic, carrot, potato, shallot, tomato and cabbage. The available water sources for irrigation are mainly river water, natural stream and some parts of underground water. The livestock reared in the woreda include cattle, shoat, equine and poultry. Grazing, crop residue, hay, tree lucerne, sasbania and industrial by-

products are the main sources of livestock feeds. In most parts of the area livestock are reared for the purpose of income sources. The area has regular rain fall distribution with an average of 950mm per annum. The main natural resources found in the woreda are eucalyptus, natural shrubs, fodder trees and acacia.

Minjarshenkora: the production system of this area is crop livestock mixed farming. Its agroecology is mainly mid altitude and has an annual production system in the main season only. Crop and livestock are more interdependent. There are also irrigation water sources from underground sources, rivers and streams. In rain fed agriculture the farmers mainly produce field crops of cereals and pulses. In the rain fed agriculture farmers produce long matured crops of wheat, tef chickpea, lentil, haricot bean and sorghum. By using irrigation water sources, the majority of them produce onion, garlic, carrot, potato and cabbage. The major cereal crops grown in the main season are tef and wheat and that of pulse crops are lentil, haricot bean and chickpea.The oil crops produced in the area are nug, sesame and linseed. The most common horticultural crops produced in the area are onion, shallot, cabbage, tomato, mango, avocado, papaya and sugarcane. The available water sources for irrigation is mainly river water, natural stream, and in some parts underground water. The livestock reared in the Woreda include Cattle, shoat, equine and poultry. The available feed sources are grazing, crop residue, and industrial bi products. In most part of the area livestock is reared for the purpose of income sources. The area has regular rain fall distribution with an average of 950mm per annum. The main natural resources found in the woreda are acacia, natural shrubs, fodder trees and eucalyptus.

3.1.2. Knowledge Management

In all *woredas*, the main extension system implemented for agricultural activities and other development interventions was through one- to- five and development team approaches.

Antsokiagemiza: farmers can have access to trainings on technology packages of fertilizer application, row planting of tef and sorghum, weed control, tillage frequency and irrigation water use in a group based arrangement through office of agriculture experts. The modules are distributed through Farmers Training Centers (FTCs) and development teams. Leaflets are distributed to individual farmers during farmers' field day and trainings.

Efratanagidim: farmers in the woreda have access to trainings on technology packages of fertilizer application, row planting of tef and sorghum, weed management, tillage frequency and irrigation water use in a group based arrangement through office of agriculture experts. The modules are distributed through FTCs, and development teams. Leaflets are distributed to individual farmers during farmers' field day and trainings.

Kewet: here farmers can have access to trainings on technology packages of fertilizer application, row planting of tef and sorghum, weed management, tillage frequency and irrigation water use in a group based arrangement through office of agriculture experts. The modules are distributed through FTCs, and development teams. Leaflets are distributed to individual farmers during farmers' field day and trainings.

Tarmaber: farmers can have access to trainings technology packages of fertilizer application, row planting and management practices of tef, wheat, barley, faba bean and sorghum production. The training also includes weed management, tillage frequency and irrigation water use in a group based arrangement through researchers, office of agriculture experts and other stakeholders. The modules are distributed through FTCs, and development teams. Leaflets are distributed to individual farmers during farmers' field day and trainings. The main extension system implemented for agricultural activities and other development intervention was through one- to- five group system and development team approaches.

Bassonawerana: farmers can have access to trainings on technology packages of fertilizer application, row planting and management practices of tef, wheat, barley, faba bean and sorghum production. The training also includes weed management, tillage frequency and irrigation water use in a group based arrangement through researchers, office of agriculture experts and other stakeholders. The modules are distributed through FTCs, and development teams. Leaflets are distributed to individual farmers during farmers' field days and trainings.

Siyadebirnawayu: farmers can have access to trainings on technology packages of fertilizer application, row planting and management practices of tef, wheat and faba bean production. The training also includes weed control, tillage frequency and irrigation water use in a group based arrangement through researchers, office of agriculture experts and other stakeholders. The modules are distributed through FTCs and development teams. Leaflets are distributed to individual farmers during farmers' field days and trainings.

Moretinajiru: Farmers can have access to trainings on technology packages of fertilizer application, row planting and management practices of tef, wheat, lentil, chickpea and faba bean production. The training also includes weed control, tillage frequency and irrigation water use in a group based arrangement through researchers, office of agriculture experts and other stakeholders. The modules are distributed through FTCs, and development teams. Leaflets are distributed to individual farmers during farmers' field days and trainings.

Minjarshenkora: Trainings were organized by different stakeholders and agricultural experts regarding production improvement of small holder farmers. The main training elements are planting techniques and management practices of tef, wheat, lentil, chickpea and faba bean production. The training also includes weed control, tillage frequency and irrigation water use in a group based arrangement through researchers, office of agriculture experts and other stakeholders. The modules are distributed through FTCs, and development teams. Leaflets are distributed to individual farmers during farmers' field day and trainings.

3.1.3. Agricultural marketing and market infrastructures

The following table shows the agricultural market infrastructures of the study areas. Agricultural marketing places and road access infrastructures are available in all the woredas with different numbers and status. The main market types are main and village markets. Some of the main markets have market facilities of fencing, shades and entrance roads.The village markets are found in the rural

kebeles while the main markets are in urban kebeles or in the woreda or small village towns.The roads are also two types all weather roads and seasonal roads. Some kebeles in each woreda have all weather roads, while majorities have seasonal roads. Antsokiagemiza, Siyadebirnawayu and Moretinajiru woredas have all muddy roads in all the villages. The other six woredas have asphalt roads at least at woreda towns. On average each woreda has 4 main and 4.4 village markets, respectively. In the case of road access each woreda has an average of 4.5 all-weather and 1.5 seasonal road accesses, respectively.

Table 1Available agricultural marketing and market infrastructure.

Infrastructures	Markets		Roads		Remark
Woreda	Main	Village	All weather	Seasonal	
Antsokiagemiza	2	4	-	2	Five kebeles have road access
Efratanagidim	5	5	5	1	Only 1 kebele has seasonal road
Kewet	8	5	6	1	Only 1 kebele has seasonal road
Tarmaber	2	3	5	2	Two kebeles have seasonal road
Bassonawerana	3	8	9	2	Two kebeles have seasonal road
Siyadebirnawayu	3	3	5	2	Two kebeles have seasonal road
Moretinajiru	3	3	4	2	Two kebeles have seasonal road
Minjarshekora	6	4	All	-	All kebeles have all weather road

3.1.4. Input supply and financial market

Input supply

In all woredas government provides fertilizer, agro chemicals, veterinary drugs, artificial insemination (AI) services, medication, improved seed, breeds (poultry, sheep), seedlings and different capacity building training services. Private sectors especially agro dealers provide inputs of herbicides, insecticides, fungicides, veterinary drugs and farm implements. The community institutions of cooperatives also supply improved seeds, fertilizers, seedlings, credit access and market access for their produces. While NGOs like ECO green, GIZ, CCF and Adhino also provide farm implements, revolving funds, improved seeds, breeds, seedlings and some training.

Financial Market

Financial (private, community and public) saving and credit cooperatives, banks and micro finances institutions facilitate financial services in the areas. Banks provide saving services whereas microfinances and cooperatives deliver both credit and saving services. But, NGOs have no role in the financial services.

3.1.5. Rural livelihood strategy, resource endowments and household economy

Antsokiagemza Woreda

The people in the woreda have the social values and customs of unique clothing style; local language accents; decoration, marriage and food preparation habits. The social norms and cultural values are also active and efficient labor utilization, group work habits, and effective time management for each agricultural activity. Available resources for the specific areas are sand, stone, ground water and developed mountains. Resource utilization trends showed that there is a different practices from place to place in the woreda in one side there is an efficient allocation of resources in some areas and miss-allocation of (extravagancy) cash resources in other areas.

Available institutions

- Social institutions

The available social institutions which are influential and have significant contribution for agricultural production include different types of cooperatives like multipurpose, saving and credit and irrigation water use cooperatives in the area. The other social institutions established and managed by the community are edirs. These useful and influential social institutions exist in all areas; they are important for any intervention with respect to mobilization of the society in child schooling, watershed management and control of free grazing.

- Religious institutions

The large number of churches and small number of mosques are available and have significant role in conflict resolution and community mobilization.

- Public institutions

The public institutions that are available in the area help the society by providing different services. They have contributions for social, cultural and economic wellbeings of the woreda. There are different level of schools (1 high school, 2 preparatory and 42 elementary), health centers (15 health posts and 5 centers), agricultural service provider institutions (15 FTCs, 15 kebele level offices of agriculture, 15 animal health post and 1 animal clinic and 1 AI service).

- Financial and market institutions

These institutions are influential for smoothening of the market transaction and financial flow. There are market places, micro finance branch offices and banks. The number of institutions includes; 2 main markets with semi structured facilities and 10 small markets without facilities, 4 micro finance offices and 2 commercial banks.

- Private institutions

The private sectors having access to inputs and output markets that contribute for the improvement of production and productivity include agro processing service providers of many grain mills and 2 drug shops.

Major Income Sources

The major income sources in the study area include agricultural and non-agricultural sectors (income from agriculture such as crop 70%, livestock 10% and multipurpose tree species 1%; income from non-agriculture sector trade 8%, wage 5%, and querying 1% and remittance fund 5%).

Efratanagidim Woreda

The people in the woreda have the social values and customs of unique clothing style, social respect, job opportunity (employment access for daily workers), marriage and food preparation habits. The social norms and cultural values are also active and efficient labor utilization, group work habits and division of labour. Some inappropriate acts and misbehaviors that need interventions include time wastage, addiction of youths and misuse of family labour. Available resources for the specific areas are sand, establishment of common youth group to use the resources with legal protection for opal, sand and stone, apiculture production on mountains, livestock feed production and marketing. Resource utilization trends showed that there is an effective demarcation of resource use bench marks like establishment of common youth group to use the resources with legal protection for opal, sand and stone, apiculture production on mountains, livestock feed production and marketing. There is efficient allocation of resources in some areas and miss allocation (extravagant) in other areas.

Available institutions

- Social institutions

The available social institutions which are influential and have significant contribution for agricultural production include different types of cooperatives like multipurpose, saving and credit and irrigation water use cooperatives in the area. The other influential social institutions established and managed by the community are edirs which exist in all areas of the woreda. They are important for development, social aids, mobilization, conflict resolution, economic and social decisions.

- Religious institutions

Churches which are available in all areas of the woreda are influential in crop production improvement of the extension system, making opening speeches and conflict resolution. Similarly, mosques are available in towns and small towns; they are influential for crop production improvement extension system, making opening speeches and conflict resolution.

- Public institutions

The public institutions that are available in the area help the society by providing different services.They and have contributions for social, cultural and economic wellbeings of the rural society. There are different level of schools (2 high schools, 1 preparatory and 60 elementary), health centers (22 health posts and 2 centers), agricultural service provider institutions (17 farmers training centers, 17 kebele level offices of agriculture, 14 animal health post, 1 animal clinic and 1 AI service).

- Financial and market institutions

These institutions are influential for smoothening of the market transaction and financial flow. There are market places, micro finance branch offices and banks. The number of institutions includes; 5 main markets with semi structured facilities, 4 micro finance offices and 2 commercial banks.

- Private institutions

The private sectors having access to inputs and output markets that contribute for the improvement of production and productivity include agro processing service providers of many grain mills, animal health clinics and 4 agricultural input suppliers.

Major Income Sources

The major income sources in the study area include agricultural and non-agricultural sectors (income from agriculture 83% and income from non-agriculture sector trade 10%, wage 3%, and small industry 4%).

Kewet Woreda

The people in the woreda have the social values and customs of unique clothing style, social respect, job opportunity (employment access to daily workers) and food preparation habits. The social norms and cultural values are also active and efficient labor utilization, good resources sharing habits, saving habits using banks. Some inappropriate acts and misbehavours that need interventions include extravagancy of resources and addiction of youths.

Available resources for the specific areas are sand, stone, opal, developed mountains and tourist areas. Resource utilization trends showed that there is an effective demarcation of resource use bench marks like establishment of common youth group to use the resources with legal protection for opal, sand and stone, apiculture production on mountains, livestock feed production and marketing. There are habits of efficient resources allocation in some areas while miss utilization (extravagancy) of it in other areas in the woreda.

Available institutions

- Social institutions

The available social institutions which are influential and have significant contribution for agricultural production include different types of cooperatives like multipurpose, saving and credit and irrigation water use cooperatives in the area. This institutions have crucial role in input supply, market access, saving and credit services, efficient use of water resources and conflict resolution.The other influential social institutions established and managed by the community are edirs. They exist in all areas and are important for development, aids, mobilization and conflict resolution.

- Religious institutions

Many churches are available in all areas of the woreda; they are influential for crop production improvement of the extension system, making opening speeches, conflict resolution. Likwise, mosques are available in towns and in some rural areas contributing for crop production improvement of the extension system, making opening speeches and conflict resolution in the society.

- Public institutions

The public institutions that are available in the area help the society by providing different services.They have contributions for social, cultural and economic wellbeing of the woreda. There are different level of schools (2 high school and 47 elementary), health service providers (18 health posts and 3 centers), agricultural service provider institutions (18 farmers training centers, 18 kebele level offices of agriculture, 9 animal health posts and 1 animal clinic and 1 AI service).

- Financial and market institutions

These institutions are influential for smoothening of the market transaction and financial flow. There are market places, micro finance branch offices and banks. The numbers of institutions include; one main market with semi structured facilities and eight small markets in the village without facilities. The market places without facilities include Werasie, Wefkelie, Ayaber, Tere, Yelen, Brbira, Abayatir and Kureberet.The financial institutions found in the area are 3 micro finance offices and 8 commercial banks.

- Private institutions

The private sectors having access to inputs and output markets that have contributions in the improvement of production and productivity include agro processing service provider of many grain mills, animal health clinics and 3 agricultural input suppliers.

Major Income Sources

The major income sources in the study area include agricultural (crop, livestock and multipurpose tree species) and non-agricultural sectors (trade, wage and small industry).

Tarmaber Woreda

The people in the woreda have the social values and customs of effective work habits, verti-sol management, input utilization and fattening practices. The social norms and cultural values include strong social interaction, positive traditional practices which include helping members during health and other problems, working together, and cooperation for any events. Available resources for the specific areas are abundant surface and ground water, fertile soil and natural forests. Resource utilization trends showed that there is effective and modern utilization of surface and ground water resources, improvement of forest production resources and improved soil and water conservation practices for sustainable resources use.

Available institutions

- *Social institutions*

The available social institutions which are influential and have significant contribution for agricultural production include different types of cooperatives like multipurpose, saving and credit, seed producer and marketing and irrigation water use cooperatives in the area. These institutions have crucial role in *input supply, market access, saving and credit services, efficient use of water resources and conflict* resolution. The other influential social institutions established and managed by the community are edirs. They exist in all areas and are important for social affairs, mobilization for water harvesting, area closure management, and soil and water conservation.

- *Religious institutions*

Churches are available in all areas of the woreda which are influential for cultural practices and mobilization of the society for soil and water conservation. Similarly, mosques are available in towns only and they are important for community mobilization and conflict resolution.

- Public institutions

The public institutions that are available in the area help the society by providing different services. They have also contributions of social, cultural and economic wellbeings. There are different level of schools (both preparatory, high school and elementary), health service providers (14 health posts, 3 centers and 1 hospital), agricultural service provider institutions (19 farmers training centers, 18 kebele level offices of agriculture, 13 animal health posts, 1 animal clinic and 1 AI service center).

- Financial and market institutions

These institutions are influential for smoothening of the market transaction and financial flow. There are market places, micro finance branch offices and banks. The numbers of institutions include; 5 main markets with semi structured facilities. The financial institutions found in the area are 3 micro finance offices and 1 commercial bank.

- Private institutions

The private sectors having access to inputs and output markets that have contributions for the improvement of production and productivity include agro processing service providers of many grain mills, 2 veterinary drug shops and 1 agricultural input suppliers.

Major Income Sources

The major income source in the study area is agriculture (crop, livestock and multipurpose tree species) while the contribution of the non-agricultural sector (trade, wage and small industry) is insignificant.

Bassonawerana Woreda

The people in the woreda have the social values and customs of respecting each other and elders, loyalty, commitment and confidence, resistance to accept new ideas and approaches, active work participation. The social norms and cultural values are also religious stands, working together, sharing of resources, participation in social ceremony, helping each other. Available resources for the specific areas are construction materials stone, sand, different vegetation having different purposes, tourism areas, vegetation of forest trees, large number of livestocks, different topography/land scape, water potentials, large area suitable for different agricultural production, diverse and suitable agro ecology, and excess human labour. Resource utilization trends showed that use of stone and sand, unidentified plant species and its propagation strategies, inefficient use of surface water, water harvesting structures are limited. Furthermore, inefficient use of labour forces, low utilization of tourism resources and limited activities in improving livestock resources are evident in the woreda.

Available institutions

- Social institutions

The available social institutions which are influential and have significant contribution for agricultural production include different types of cooperatives like multipurpose, saving and credit, seed producer and marketing, milk producer and marketing, natural resource management and irrigation water use

cooperatives in the area. There are a total of 56 socially established cooperatives (20 multipurpose, 5 irrigation water use, 18 saving and credit, 2 seed producer and marketing, 7 milk producer and marketing, 4 natural resource management and use and 1 beekeeping). These institutions have crucial role in input supply, market access, saving and credit services, efficient use of water resources, capital accumulation and conflict resolution.

The other influential social institutions established and managed by the community are edirs. They exist in all areas and are important for support each other respect the bylaws, mobilize the society to different action.

- Religious institutions

Churches are available in all areas of the woreda. The majority of the people are Orthodox Christians, each member of the society is under the umbrella of the church, brings acceptances for good will improvement in urban and per urban areas.

- Public institutions

The public institutions that are available in the area help the society by providing different services. They have contributions in the social, cultural, and economic wellbeing of the society in the woreda. There are different level of schools (both preparatory, high school and elementary), health service providers (31 health posts and 4 centers and 2 hospitals), agricultural service provider institutions (18 farmers training centers with full facilities, 31 kebele level offices of agriculture, 20 animal health post and 1 animal clinic and 1 AI service).

- Financial and market institutions

These institutions are influential for smoothening of the market transaction and financial flow. There are market places, micro finance branch offices and banks. The numbers of institutions include; 3 main markets with semi structured facilities and 8 small or village markets with no market facilities. The financial institutions found in the area are 5 micro finance offices and 15 public and private commercial banks.

- Private institutions

The private sectors having access to inputs and output markets that have contributions for the improvement of production and productivity include agro processing service providers, 5 veterinary drug shops, more than 10 human drug shops, health clinics and 2 agricultural input suppliers.

Major Income sources

Agriculture (crop, livestock and multipurpose tree species) is the major income source of the woreda accounting for 98% of the total revenue while the non-agricultural sectors (trade, wage and small industry) contributes for 2% of the total income.

Siyadebirnawayu Woreda

The people in the *woreda* have the social values and customs of effective work habits, verti soil management, input utilization and fattening practices. The social norms and cultural values are also group works, participation in social ceremonies, helping each other, helping group members during health and other problems. Available resources for the specific areas are productive soils, livestock products, large and suitable areas for different agricultural productions, and excess human labour.

Resource utilization trends show that the people have good habits of proper use of land resources for optimum production with good soil drainage practicesand improved fattening practices. On the other hand, inefficient use of surface water and limited water harvesting structures require interventions so as to enhance production and productivity through irrigation agriculture.

Available institutions

- Social institutions

The available social institutions which are influential and have significant contribution for agricultural production include different types of cooperatives like multipurpose, saving and credit, seed producer and marketing, milk producer and marketing, natural resource management and irrigation water use cooperatives in the area. There are a total of 56 socially established cooperatives (10 multipurpose, 1 irrigation water use, 9 saving and credit, 4 seed producer and marketing, one milk producer and marketing). These institutions have crucial role in input supply, market access saving and credit services efficient use of water resources, capital accumulation and conflict resolution. The other influential social institutions established and managed by the community are edirs. They exist in all areas and are important for social affairs, mobilization for water harvesting, area closure management and soil and water conservation.

- Religious institutions

Churches are available in all areas of the woreda. The majority of residents are Orthodox Christians; churches are influential for cultural practices and social mobilization for soil and water conservation.

- Public institutions

The public institutions that are available in the area help the society by providing different services and have contributions for social, cultural, economic wellbeing. There are different level of schools (1 vocational, 1 preparatory, 2 high schools and 37 elementary), health service providers (14 health posts and 3 centers and 1 hospital), agricultural service provider institutions (12 farmers training centers, 13 kebele level offices of agriculture, 10 animal health clinics and 1 AI service).

- Financial and market institutions

These institutions are influential for smoothening the market transaction and financial flow. There are market places, micro finance branch offices and banks. The numbers of institutions include; 2 main markets with semi structured facilities and 4 small or village markets with no market facilities. The financial institutions found in the area are 3 micro finance offices and 1 commercial bank.

- Private institutions

The private sectors having access to inputs and output markets that improve production and productivity include agro processing service providers, 6 veterinary drug shops and 2 agricultural input suppliers.

Major Income Sources

The major income sources in the study area are the agricultural sector (crop, livestock and multipurpose tree species) and the non-agricultural sector (trade, wage and small industry).

Moretinajiru Woreda

The people in this woreda have the social values and customs of effective work habits, vertisol management, input utilization and fattening practices. The social norms and cultural values are also social interaction, feeding habit of meat, helping social groups during health and other problems and working together. Available resources for the specific areas are productive soils, livestock products, large and suitable area for different agricultural productions and excess human labour. Resource utilization trends show that the people have good habits of proper use of land resources for optimum production with good soil drainage practices, improved fattening practices. However, inefficient use of surface water and limited water harvesting structures are the problems that need interventions to boost up agricultural production and productivity.

Available institutions

- Social institutions

The available social institutions which are influential and have significant contribution for agricultural production include different types of cooperatives like multipurpose, saving and credit, seed producer and marketing, milk producer and marketing, natural resource management and irrigation water use cooperatives in the area. There are a total of 56 socially established cooperatives (8 multipurpose and 7 seed producer and marketing). These institutions have crucial role in input supply, market access, saving and credit services and capital accumulation. The other influential social institutions established and managed by the community are edirs. More than 200 associations exist in all areas and they are important for social affairs, mobilization and soil and water conservation undertakings.

- Religious institutions

Churches are available in most areas of the woreda. 99.9% of the population are Orthodox Christians, Churches are influential for cultural practices, conflict resolution and social mobilization for soil and water conservation.

- Public institutions

The public institutions that are available in the area help the society by providing different services. They have contributions for social, cultural and economic wellbeing. There are different level of schools (1 preparatory, 2 high schools and 37 elementary), health service providers (18 health posts and 4 centers), agricultural service provider institutions (12 farmers training centers, 13 kebele level offices of agriculture, 10 animal health clinics and 1 AI service).

- Financial and market institutions

These institutions are influential for smoothening the market transaction and financial flow. There are market places, micro finance branch offices and banks. The numbers of institutions include; 1 main markets with semi structured facilities and 5 small or village markets with no market facilities. The financial institutions found in the area are 3 micro finance offices and 1 commercial bank.

- Private institutions

The private sectors having access to inputs and output markets that have contributions for the improvement of production and productivity include agro processing service providers, 3 veterinary drug shops, 3 animal health clinics and 2 agricultural input suppliers.

Major Income Sources

The major income source in the study area is the agricultural sector (crop 74%, livestock 18% and multipurpose tree species 0.75%) with a minimal contribution from the non-agricultural sector (trade, 3%, wage 4% and querying 0.25%).

Minjarshenkora Woreda

The people have the social values and customs of effective work habits, vertisols management, input utilization, fattening practices, music, religious ceremony, clothing and social interaction.The social norms and cultural values are also social interaction, feeding habits of meat, efficient work and good technology adoption behavior. Available resources for the specific areas are productive soils, livestock products, large and suitable area for different agricultural production, and stone and natural vegetation. Resource utilization trends show that the people have good habits of proper use of land resources for optimum production with good soil drainage practices, improved fattening practices, querying activities are allocated for common interest groups and private utilization.

Available institutions

- Social institutions

The available social institutions which are influential and have significant contribution for agricultural production include different types of cooperatives like multipurpose, saving and credit, seed producer and marketing, milk producer and marketing, natural resource management and irrigation water use cooperatives in the area. There are 56 socially established cooperatives (22 multipurpose and 20 saving and credit, 6 irrigation water use, 4 consumer and 2 seed producer and marketing). These institutions have crucial role in input supply, market access, saving and credit services and capital accumulation. The other influential social institutions established and managed by the community are funeral associations. These associations exist in all areas which are important for social interaction and communication, mobilization and development intervention.

- Religious institutions

Churches are available in all areas of the *woreda and they are* influential for mobilization, conflict resolution, and social interaction. Mosques are found in towns and they are important for conflict resolution and social interaction.

- Public institutions

The public institutions that are available in the area help the society by providing different services. They have contributions for social, cultural and economic wellbeing. There are different level of schools (3 preparatory, 3 high school and 64 elementary), health service providers (29 posts, 5 centers and 1 hospital), agricultural service provider institutions (27 farmers training centers, 29 kebele level offices of agriculture, 27 animal health clinics and 1 AI service).

- Financial and market institutions

These institutions are influential for smoothening the market transaction and financial flow. There are market places, micro finance branch offices and banks. The numbers of institutions include; 2 main markets with semi structured facilities and 3 small or village markets with no market facilities. The financial institutions found in the area are 3 micro finance offices and 9 commercial banks.

- Private institutions

The private sectors having access to inputs and output markets that have contribution for the improvement of production and productivity include agro processing service providers, 1 veterinary drug shops, 6 animal health clinics and 9 agricultural input suppliers.

Major Income Sources

The major income source in the study area is the agricultural sector (crop, livestock and multipurpose tree species) and the non-agricultural sectors have their own (trade, wage and querying) economic contributions.

3.1.6. Cross cutting issues

The main cross cutting issues discussed here are nutrition, gender and climate smart agriculture. The nutrition which is composed of animal and plant products is identified to be variable in the study areas. Animal products are relatively similar. With respect to gender issues, the division of labour in production, management and resource use decisions are also variable depending on the type of agricultural resources available and produced. Farmers and agricultural service delivery institutions adjusted and implemented different climate management systems to adapt and mitigate the climate change events. The detail of these issues provided as follows:-

Antsokiyagemza Woreda

- **Nutrition**

The main food items utilized are composed of crops of cereals, livestock products of egg, meat, and milk combinations. The main diet combinations consist mainly of cereals such as sorghum, tef, maize, wheat and barley with unusual small portion of vegetables like onion, tomato, carrot, kale and cabbage. Those cereals are also sometimes combined with livestock products of egg, milk and meat occasionally. When people eat cereal vegetable combinations, tef, maize and sorghum are mainly combined with potato and pepper. On the other hand, when people eat cereal with livestock product combinations; sorghum, tef and wheat are mainly combined with egg, meat and milk. By the same token, when people eat vegetables with livestock product combinations, potato and cabbage will be combined with meat and milk products of butter and cheese.

Farm household and survival strategies for food shortage

People have different survival strategies for different uncertain phenomena of food shortage and disease out breaks. The main survival strategies practiced for food shortage phenomena are food aid by external intervention and self-saving habits of the society from the previous products. The major survival strategies for livestock diseases and out breaks used medicaments and mass vaccination, respectively. And the survival strategies for disease and pest outbreak on crop, people use different chemicals and integrated pest management for the expected outbreaks. People have no survival strategy mechanisms on disease and out breaks of multipurpose tree species; this is due to lack of introduced technologies in the area.

- **Gender (division of labor, access and decision making)**

Gender division of labor

The male based farming/agricultural production activities are ploughing, cultivation, harvesting, threshing, transportation and marketing of crop production, medication, feeding and marketing of cattle, conservation, participation of training on natural resource production and management. While the female based farming /agricultural production activitiesare seed cleaning, home garden cultivation of crops, milking, processing of milk and barn cleaning of animals in livestock production and no specific activities on natural resource production and management. The resources in male headed household all are owned jointly.

Decision making

Decisions concerning farm activities are mainly made by men themselves with and without consulting their wives and/or their daughters. Males decide the type of crop to be grown in each specific field, while the farm/household decisions are made by females with or without consulting their husbands or sons include household chore, food items, and small scale poultry marketing.

- **Climate Smart Agriculture (CSA) and identifying climate change parameters**

The identified sensible climate change parameters in the area are shifting of agriculture from rain fed to irrigation based productionon through the use of ground water, incorporate organic manure to improve soil fertility for cereal production and implementation of crop rotation practices on cereal with cereal and pulse and oil crops interchangeable.

Climate change adaption and mitigation practices:

Farmers tried to continue production of the same crops of sorghum and tef having special merits of short maturity, low moisture requirement and tolerance of moisture stress. The demand for short matured and drought tolerant improved varieties of all crops are increasing from time to time. The area covered by mung bean crop which has a very short field stay is increased year after year. The main mitigation practices implemented to maintain the climate to be good and suitable for agricultural practices and for day to day human activities include an improvement of soil and water conservation campaigns, afforestation and area closure practices.

Survival strategies for drought and water shortage

When drought happened in the area, people tried to increase production of crops and livestock feeds using irrigation, reduce the number of animals and purchase human consumables and livestock feed to withstand drought phenomena. The survival strategies for the shortage of water are transportation, seasonal movement and harvesting of ground water.

Efratanagidim Woreda

- **Nutrition**

The main food items utilized are composed of crops of cereals (sorghum, tef, barley and wheat), pulses of (faba bean and field pea), vegetables and fruits (onion, cabbage, tomato, banana, papaya and kale) and livestock products of egg, meat and milk combinations. The main diet combinations consist

mainly of cereals such as sorghum, tef and barley with unusual small portion of vegetables like kale, onion and cabbage. Those cereals are also sometimes combined with livestock products of milk, milk products and meat occasionally. When people are eating cereal vegetable combinations, tef, maize and sorghum (cereals) are mainly combined with potato and pepper (vegetables). Similarly, when people eat cereal with livestock product combinations; sorghum, tef and wheat (cereals) are mainly combined with egg, meat and milk (livestock). When people eat vegetables with livestock product combinations, onion (vegetable) will be combined with egg and meat (livestock).

Farm household and survival strategies for food shortage

People have different survival strategies for different uncertain phenomena of food shortage and disease out breaks. The main survival strategies practiced at times of food shortage are food aid by GOs and NGOs (external intervention), self-saving habits of the society from the previous products and production, short matured crops with available means of moisture, purchase food by selling of animals.

Survival strategies for disease and pest outbreak

The major survival strategies for livestock diseases and out breaks used are isolation of diseased animals, identification of causes, access and provision of medicaments and mass vaccination, respectively. And the survival strategies for disease and pest outbreaks on crops, include management of the damages through the use of different approaches such as mobilization of the community, use of chemicals, and integrated pest management. People have no survival strategy mechanisms for disease and out breaks of multipurpose tree species as a result of lack of introduced technologies in the area.

- **Gender (division of labor, access and decision making)**

Gender division of labor

The most common male based farming/agricultural production activities are ploughing, harvesting, threshing and transportation of crops produced, health management, herding, marketing and feeding of cattle and beehives, plantation, seedling preparation and transplanting, marketing of natural resource production and management. The most common female based farming/agriculture production activities are seed cleaning, weeding, home garden crop cultivation and marketing of home garden produces , milking, processing of milk, barn cleaning and marketing of dairy products, poultry farming and marketing,conservation, transportation of seedlings and natural resource management. Jointly performed agricultural activities include marketing and storage of crops and soil and water conservation/ natural resources management.

Resource access and decision making

In male headed households the resources owned by husbands or males are cash, fixed assets like house, trees and vegetables of irrigation produces. While, the resources owned by females or wives in the same household are poultry, milk and milk products, home garden vegetables and small amount of cash.

Decision making

The main farm decisions are predominantly made by men with and without consulting their wives and/or their daughters. These includethe type of crop to be grown in each specific fields, marketing of livestock, resource transfer both cash and assets, renting of lands, schooling of children. While, the farm/household decisions made by females with or without consulting their husbands and/or their sons include household chores, food items and poultry marketing. Farm decisions like social participation, diet preparation, home and, kitchen management and purchasing of consumable items were lead by females.

Climate smart agriculture (CSA) and identifying climate change parameters

The identified sensible climate change parameters in the area are shifting of agriculture from rain fed to irrigation based production through the use of ground water, incorporation of organic manure to improve soil fertility for vegetable production and implementation of cereal and vegetable crop rotation practices interchangeablly.

Climate change adaption and mititgation practices

Farmers tried to continue production of the same crops of sorghum and tef having special merits of short maturity, low moisture requirement and tolerance to moisture stress. The demand for short matured and drought tolerant improved varieties of all crops are increasing from time to time. Productions of short matured crops and applications of organic manures for the production of vegetables are increasing year after year to enhance production. The main mitigation practices implemented to maintain the climate to be good and suitable for agricultural practices and for day to day human activities include an improvement of soil and water conservation campaigns, afforestation and area closure practices.

Survival strategies for drought and water shortage

When drought happened in the area, people tried to increase production of crops and livestock feeds using irrigation, reduce the number of animals, transportation of food and other consumables and livestock feeds to withstand the current drought. The survival strategies for the shortage of water are transportation, seasonal movement to long distances and harvesting of ground water.

Kewet Woreda

- **Nutrition**

The main food items utilized are composed of crops of cereals, pulses, vegetables, fruits and livestock products of egg, meat, and milk combinations. The main diet combinations consist mainly cereal based sorghum, tef, maize, wheat and barley with combinations of faba bean, field pea, lentil and unusually small portion of vegetables like onion, tomato, carrot, kale, and cabbage. Those cereals are also combined with livestock products of egg, milk and meat occasionally. When people eat mainly cereal and vegetable combinations, tef, sorghum and wheat (cereals) are mainly combined with onion (a vegetable). When people eat cereal with livestock product combinations; sorghum, tef and wheat (cereals) are mainly combined with milk. On the other hand, when people eat vegetables with

livestock product combinations, onion (vegetable) will be combined with meat, milk products of butter and cheese (livestock).

Farm household and survival strategies

People have different survival strategies when food shortage and disease out breaks occur uncertainly.The main survival strategies practiced at times of food shortage are food aids by GOs and NGOs (external intervention), and purchase of food by selling of animals and cash gained from remittance. The major survival strategies for livestock diseases and out breaks used are medicaments and mass vaccination, respectively. And the survival strategies for disease and pest outbreak on crop include use of different chemicals and integrated pest management. Neverthless, people have no survival strategy mechanisms for disease and out breaks of multipurpose tree species as a result of lack of introduced technologies in the area.

- **Gender (division of labor, access and decision making)**

Gender division of labor

The most common male based farming/agricultural production activities are ploughing; cultivation; harvesting; threshing and transportation of crops produced; herding; health management; marketing and feeding of cattle, small ruminants and beehives; seedling preparation and transplanting; marketing of forest products and natural resource management. The most common female based farming/different agriculture activities are seed cleaning; weeding; marketing of home garden produced crops; milking; processing of milk; poultry production and marketing; barn cleaning and management of cattle. However, there are no specific activities on natural resource production and management. The common agricultural activities operating jointly are soil and water conservation and storage and marketing of crop products.

Resource access and decision making

Resource access

In male headed households the resources owned by males or husbands are cash, fixed assets like house, trees and vegetables of irrigation produces. While the resources owned by females or wives in the same household are poultry, milk and milk products, home garden vegetables and small amount of cash.

Decision making

The main farm decisions made by the husband with or without consultinghis wife and/or his daughter include market exchange, resource transfer both cash and assets, the type of crop to be grown in each specific field, renting of lands, schooling decision. While the farm/household decisions made by the wife with or without consulting her husband and/or her son include household chores, food items, diet preparation, home management, kitchen management and purchasing of consumable items.

- **Climate Smart Agriculture (CSA) and identifying climate change parameters**

The identified sensible climate change parameters in the area are shifting of agriculture from rain fed to irrigation based production through the use of ground water, incorporation of organic manure to improve soil fertility for cereal production and implementation of crop rotation practices on cereal with cereal and pulse and oil crops interchangeablly.

Climate change adaption and mitigation practices

Farmers tried to continue production of the same crops of sorghum and tef having special merits of short maturity, low moisture requirement and tolerance to moisture stress. The demand for short matured and drought tolerant improved varieties of all crops are increasing from time to time. The area covered by mung bean crop which has a very short field stay is increased year after year. The main mitigation practices implemented to maintain the climate to be good and suitable for agricultural practices and for day to day human activities include an improvement of soil and water conservation campaigns, afforestation and area closure practices.

Survival strategies for drought and water shortage

When drought happened in the area the people tried to increase production of crops and livestock feeds using irrigation and reduce the number of animals by transferring them to other areas to survive the current drought. The survival strategies for the shortage of water are transportation and seasonal movement.

TarmaberWoreda

- **Nutrition**

The main food items utilized are composed of crops of cereals, pulses and livestock products. The main crop diet consists mainly of cereal based sorghum, tef, wheat, barley and faba bean with small portion of vegetables like potato and kale. Those cereals are also sometimes combined with livestock products of egg, milk and meat occasionally. When people eat cereals with vegetable combinations, tef, barley, wheat and sorghum (cereals) are mainly combined with potato and kale (vegetables). When people eat cereal combined with livestock product, sorghum, tef, wheat and barley (cereals) are combined with egg and milk products. Furthermore, when they eat vegetables with livestock product combinations, potato and garlic (vegetable) combined with milk products of butter, cheese and meat.

People have different survival strategies for food shortage and disease out breaks. The main survival strategies practiced at times of food shortage are food aid by GOs and NGOs (external intervention), purchase of food by selling of animals and renting out farm lands, search for local credits either in kind or cash to purchase food, males working as daily laborers and family migration. The major survival strategies for livestock diseases and out breaks include medicaments for the sick and mass vaccination for the herd. And the survival strategies for disease and pest outbreaks of crops include use of different cultural practices, chemicals and integrated pest management. People have no survival strategy for disease and out breaks of multipurpose tree species because of lack of introduced technologies in the area.

- **Gender (division of labor, access and decision making)**

Gender division of labor

The common male based farming/agriculture production activities are land preparation, plantation, weeding, harvesting of wheat and other crops, threshing, transportation, marketing, storage of crop produced, feed collection and provision , construction of shelter, management of draught power animals, marketing of fattened animals, and mass mobilization, preparation of stone bunds and soil bunds, seedlings preparation, plantation and management of field vegetation. On the other hand, the female based farming/agricultural production activities are plantation, weeding, harvesting of crops other than wheat, storage and marketing of crop produced, feeding of dairy cows and poultry, milking and processing, marketing of dairy products, home garden plantations and natural resource production and management.

Resource access and decision making

In male headed households the resources dominantly owned by husbands/males include cash, livestock, small ruminants and farming tools, while the resources dominantly owned by wives/females are milk products, poultry, small amount of cash gained from small grain marketing and household tools. The main farm decisions made by husbands/males with or without consulting their wives and/or their daughters include buying of animals, type of crops to be grown, and renting in land, while the farm/household decisions made by wives/females with or without consulting their husbands and/or their sons include social participation.

- **Climate smart agriculture (CSA) and identified climate change parameters**

The identified climate change parameters in the area are shifting of agriculture from cereal to pulse crops and from bimodal production to unimodal/single production (due to low rainfall distribution) early planting of crops and incorporation of organic manure to improve the soil.

Climate change adaption and mitigation practices

Farmers tried to continue production of the same crops having special merits of short maturity, low moisture requirement and tolerance to moisture stress. They practices early planting. The demand for short matured and drought tolerant improved varieties of all crops are increasing from time to time. The main mitigation practices implemented to maintain the climate to be good and suitable for agricultural practices and for day to day human activities include an improvement of soil and water conservation campaigns and afforestation.

Survival strategies for drought and water shortage

When drought happened in the area people tried to increase production of crops and livestock feeds through the use of irrigation to survive the drought. The survival strategies for the shortage of water are transportation, use of water harvesting strategies and moving long distances, wise use of water, trecking of animals to another place.

Bassonawerana Woreda

- **Nutrition**

The main food crops utilized are composed of crops of cereals, pulses and livestock products. The main diet combinations comprise of mainly cereal based barley and wheat, pulses of faba bean and lentil with unusual small portion of vegetables like potato and kale. Cereals are also sometimes combined with livestock products of egg, milk and rarely meat. When people eat cereal with vegetable combinations, tef, barley, wheat and sorghum (cereal) are mainly combined with vegetables of potato and kale (vegetables) and when the people eat cereal with livestock product combinations, wheat and barley are mainly combined with milk products. When they eat vegetables with livestock product combinations, potato and garlic will be combined with milk products of butter and meat. People have different survival strategies for food shortage and disease out breaks. The main survival strategies practiced for food shortage are food aid by GOs and NGOs (external intervention), purchase of food by selling of animals and forest products, borrowing from family and neighbors, saving of grain and money from the previous year. The major survival strategies for livestock diseases and out breaks include isolation of the diseased animals, use of d medicaments for the sick and mobilization to mass vaccination, Similarly, the survival strategies for disease and pest outbreaks of crops include use of early warning information and different cultural practices and chemicals and integrated pest management. People have no survival strategy mechanisms on disease out breaks of multipurpose tree species because of lack of introduced technologies in the area.

- **Gender (division of labor, access and decision making)**

Gender division of labor

Male based farming/agricultural production activities are land preparation, harvesting, threshing, transportation, storage and marketing of crop produced. Regarding livestock production, home feeding of animals, milking and marketing of poultry and milk and milk products handling are mainly managed by female family mambers. On the other hand, plantation and marketing of trees, physical and biological soil conservation practices, seedling preparation for natural resource management in male headed households is carried out by men. The female based farming activities are weeding, threshing, transportation, selling of low value crops, feeding of dairy cows and poultry, milking and processing, marketing of dairy products and minor participation in soil and water conservation practices.

Resource access and decision making

In male headed households the resources are dominantly owned by male including grain, livestock and livestock products and cash. Females, on the other hand, dominantly own household furniture, food items and other inputs. The main farm decisions made by the husband with or without consulting his wife and/or his daughter are marketing of grain and livestock, transfer of money and other assets, land renting, plantation of crops and trees on farm lands. While the farm/household decisions made by the wife with or without consulting her husband and/or son include schooling of childern, food item and social participation.

- **Climate smart agriculture (CSA) and identified climate change parameters**

The identified sensible climate change parameters in the area are shifting of agriculture like late plantation of barley, mixed cropping for diversification, use of early maturing varieties, use of inputs, reduced fallowing, diversification, shifting of production from short season to main season and removal of excess water from their farms. They practiced shifting of the farm lands from crop production to perineal trees plantation.

Climate adaptability practices such as shifting of cultivation, moisture conservation, early planting, following of rain fall distribution patterns to grow different types of crops depending on weather changes, use of irrigation resources, and use of early maturing improved varieties. Farmers tried to continue production of the same crops on the existing situations using short maturing and moisture stress tolerant varieties with the avilable low moisture.. They practice early plantingand apply organic manure and crop rotation of cereals with pulse crops. The main mitigation practices implemented to maintain the climate to be good and suitable for agricultural practices and for day to day human activities include natural resource conservation, reduce runoff and improve infiltration rate of soil, afforestation and plantation of trees on farm lands.

- ✓ **Survival strategies for drought and water shortage**

When drought happened in the area, people tried to reduce livestock number. sell of forest product, hired as daily laborer, exchange of products, and participate in trading activities. The survival strategies for the shortage of water are moving long distance and trecking animals from place to place.

Siyadebirnawayu Woreda

- **Nutrition**

Food crops utilized are composed of crops of cereals, pulses and livestock products. The main diet combinations consist of mainly cereal based tef and wheat; pulses such as faba bean, chickpea and lentil with small portion of vegetables like potato and kale. Those cereals are also sometimes combined with livestock products of egg, milk and meat occasionally. When people eat cereals with vegetable combinations, tef and wheat are mainly combined with cabbage, potato, tomato and kale. When people eat cereals with livestock product combinations, tef, and wheat are mainly combined with egg and milk products.On the other hand, when people eat vegetables with livestock product combinations, potato and garlic will be combined with meat and milk products of butter and cheese.

Farm household and survival strategies

People have different survival strategies for food shortage and disease out breaks.The main survival strategies practiced at times of food shortage include access to local credit, migration of men as laborers, purchase of food by selling animals and land renting. The major survival strategies for livestock diseases out breaks include use of medicaments for the sick and mass vaccination for the herd. Likewise, the survival strategies for disease and pest outbreaks on crops include use of different cultural practices, chemicals and integrated pest management. Neverthless, farmers have no survival

strategy/escaping mechanisms for disease out breaks of multipurpose tree species due to the lack of introduced technologies in the area.

- **Gender (division of labor, access and decision making)**

Gender division of labor

The common male based farming/agricultural production activities are land preparation, plantation, weeding, harvesting of wheat and other crops, threshing, transportation, marketing, storage of crops produced, feed collection and provision, construction of shelter, management of draught power animals, marketing of fattened animals,involvement in mass mobilization, preparation of stone bunds and soil bunds, seedlings preparationand plantation and management of field vegetation.

Female farming activities

The most common female based farming/agriculture production activities are plantation, weeding, harvesting of crops other than wheat, storage and marketing of crops produced, feeding of dairy cows and poultry, milking and processing, marketing of dairy products, home garden plantations, and natural resource production and management.

Resource access and decision making

In male headed households the resources dominantly owned by males include cash, livestock, small ruminants and farm tools whereas the resources dominantly owned by females are milk products, poultry, small amount of cash gained from small grain marketing and household tools. The main farm decisions made by the husband with or without consulting his wife and/or his daughter are buying of animals, type of crops to be grown, and renting in land, while the farm/household decision made by the wife with or without consulting her husband and/or her son includes social participation.

- **Climate smart agriculture (CSA) and identifying climate change parameters**

The identified sensible climate change parameters in the area are shifting of agriculture from cereal to pulse crops, early planting and crop rotation pulse with cereals.

Climate change adaption and mitigation practices

Farmers tried to continue production of the same crops having special merits of short maturity, early plantings of crops and sowing of early maturing crops. The demand for short/early maturing improved varieties of all crops is increasing from time to time. The main mitigation practices implemented to maintain the climate to be good and suitable for agricultural practices and for day to day human activities include an environmental protection, afforestation and soil and water conservation.

Survival strategies for drought and water shortage

When drought happened in the area, the people tried to survive the drought using previously saved products. The survival strategies for the shortage of water are moving long distances, wise use of water and trecking of animals to other places.

Moretinajiru Woreda

- **Nutrition**

Food items utilized are composed of crops of cereals, pulses and livestock products. The main diet combinations comprise mainly of cereal based wheat and tef and pulses consisting of faba bean, chickpea, and lentil with unusual small portion of vegetables like potato and kale. Cereals sometimes are combined with livestock products of egg, milk and meat occasionally. When the people eat cereals with vegetable combinations, tef, barley, and wheat are mainly combined with potato, garlic and kale. On the other hand, when people eat cereal in combination with livestock product; tef, wheat and barley are mainly combined with egg and milk products. People are not experienced to combine vegetables with livestock products.

- ***Farm household and survival strategies***

The main survival strategies practiced during food shortage include searching for local credit, working as daily laborer, livestock fattening, petty trading and migration of male laborers, purchase of food by selling animals and land renting. The major survival strategies for livestock diseases out breaks include use of medicaments for the sick and mass vaccination for the herd. Likewise, the survival strategies for disease and pest outbreaks of crops include use of different cultural practices, chemicals and integrated pest management. People have no survival strategy/coping mechanisms for disease out break of multipurpose tree species due to lack of introduced technologies in the area.

- **Gender (division of labor, access and decision making)**

Gender division of labor

The most common male based farming/agriculture production activities are land preparation, plantation, weeding, harvesting, threshing, transportation, marketing, storage of crops produced, feed collection and provision , construction of shelter, management of draught power animals, marketing of fattened animals, mass mobilization, preparation of stone bunds and soil bunds, seedlings preparation, plantation and management of field vegetation. The most common female based farming/ agriculture production activities are plantation, weeding, harvesting of crops other than wheat, storage and marketing of crops produced, feeding of dairy cows and poultry, milking and processing, marketing of dairy products, home garden plantations and natural resource production and management.

Resource access and decision making

Resource access

In male headed household the resources dominantly owned by males include cash, livestock, small ruminants and farming tools. On the other hand, the resources dominantly owned by females are milk products, poultry, small amount of cash gained from small grain marketing and household tools.

Decision making

The main farm decisions made by the husband with or without consulting his wife and/or his daughter include buying of animals, type of crops grown and renting in land, while the farm/household decisions made by the wife with or without consulting her husband and/or son include social participation and marketing of consumable goods.

- **Climate Smart Agriculture (CSA) = identifying climate change parameters, climate change adaption practices, mitigation**

The identified sensible climate change parameters in the area are shifting of agriculture from cereals to pulse crops, early planting, and application of organic manure in low land areas and crop rotation of pulse crops with cereal crops.

Climate change adaption and mitigation practices

Farmers tried to continue with early planting of crops, planting of early maturing varieties. The demand for short maturing and drought tolerant improved varieties of all crops are increasing from time to time. The main mitigation practices implemented to maintain the climate to be good and suitable for agricultural practices and for day to day human activities include an improvement of practices on environmental protection, afforestation and soil and water conservation.

Survival strategies for drought and water shortage

People have no proven exposure for drought and thus it is difficult for them to judge the survival/coping strategies. The survival strategies for water shortage are hand dug wells, moving long distance, wise use of water, trecking of animals to other places.

Minjarshenkora Woreda

- **Nutrition**

The main food crops utilized are composed of crops of cereals, pulses and livestock products. The main diet combinations consist of mainly of cereal based tef, wheat and sorghum and pulses such as chickpea and lentil with unusual small portion of vegetables like potato and kale. Cereals are also sometimes combined with livestock products of meat, egg and milk products. When people eat cereal with vegetable combinations, tef, wheat and sorghum are mainly combined with potato, onion, cabbage and kale. On the other hand, when the people eat cereal with livestock product combinations, tef, wheat and sorghum are mainly combined with meat and milk products. Similariy, when the people eat vegetables with livestock product combinations, potato and gariic will be combined with meat and milk products of butter.

Farm household and survival strategies:

People have different survival strategies for food shortage and disease out breaks.The main survival strategies practiced for food shortage are saving of grain and money from the previous years, food aid by GOs and NGOs (external intervention), self-help with relatives, purchase of food by selling of animals and forest products, borrowing from family and neighbors and migration. The major survival

strategies for livestock diseases out breaks include isolation of the diseased livestock, use of medicaments for the sick animals, local treatments and mobilization of the herd for mass vaccination. Similarly, the survival strategies for disease and pest outbreaks of crops include use of chemicals and cultural practices and integrated pest management. People use chemical and traditional practices as survival strategies/coping mechanisms for diseases out breaks of multipurpose tree species.

- **Gender (division of labor, access and decision making)**

Gender division of labor

The most common male based farming/agricultural production activities are ploughing, plantation, harvesting, threshing, weeding, transportation, marketing, storage on crops produced, home feeding, milking, marketing of poultry and milk and milk byproducts, plantation, seedling preparation, and natural resource management. The most common female based farming/agriculture production activities are weeding, cultivation, plantation of vegetables, seed cleaning, marketing of crops produced, milking, feeding family members, processing, marketing of milk products, poultry management and marketing, and minor participation in soil and water conservation practices of natural resource management.

Resource access and decision making

The resources dominantly owned by males in male headed households are grain, cattle, sheep, goat, cash, land tenure and plantation, while the resources dominantly owned by females are milk products and byproducts, poultry, and social participation. The main farm decisions made by the husband with or without consulting his wife and/or his daughter are plantation, input purchase and livestock marketing, while the farm/household decision made by the wife with or without consulting her husband and/or her son is determination of diet type.

- **Climate smart agriculture (CSA) and identifying climate change parameters**

The identified sensible climate change parameters in the area are shifting of agriculture from cereal and chickpea to onion production, utilization of manures, rotation of legumes with cereals, diversification and removal of excess water from their farm.

Climate change adaptation and mitigation practices

Climate adaptability practices in the area indicated that there is shift of cultivation, moisture conservation, early planting, use of short matured seeds, water harvesting, use of irrigation, and use of early maturing improved varieties. Farmers tried to continue production of the same crops in the existing situations using short matured and moisture deficit tolerant varieties. They practice early planting, apply organic manure and rotate cereals with pulse crops. The main mitigation practices implemented to maintain the climate to be good and suitable for agricultural practices and for day to day human activities include afforestation, soil and water conservation, replantation, area closure, cut and carry feeding system and reduce free grazing.

Survival strategies for drought and water shortage

When drought happened in the area, people tried to access food aid, migrate to other areas, sale animals and move them to other areas.The survival strategies for the shortage of water are fetching of water from other areas and transfer to available water sources.

3.1.7. Major socio-economic related constraints and possible interventions

Antsokiyagemza

- **Constraints**
  - Lack of agro processing technologies for tomato and onion;
  - Post-harvest loss of sorghum and maize due to weevils;
  - Lack of different improved technologies for demonstration;
  - Lack of technology shopping;
  - Shortage of training access for DAs and experts;
  - Lack of market linkages for inputs and outputs;
  - Lack of access to resources and decision making role of women farmers;
  - Limited diet combination of cereals and pulses food habits;
- **Intervention areas**
  - Demonstration of available technologies for different agro ecologies;
  - Introduction of shelf life improvement technologies;
  - Introduction of post-harvest handling tools;
  - Provision of trainings and awareness creation on food habits;

Efratanagidim

- **Constraints**
  - Post-harvest lose reduction/ shelf life improvement on tomato and onion;
  - High commodity price on tef and lentil as compared to other areas;
  - Brokers intervention on crop marketing;
  - Lack of standardized measurement on produces of onion, cabbage and potato;
  - Lack of access to resources and decision making role of women farmers;
  - Limited diet combination of cereals based pulse combination food habits;
- **Intervention areas**
  - Conducting different market studies;
  - Making market linkage with different market agents and understanding the common shares;
  - Introduction of shelf life improvement technologies;
  - Introduction of post-harvest handling tools;
  - Provision of trainings and awareness creation;

Kewet

- **Constraints**
  - Quality lose due to post-harvest problems;
  - Failure to identifiy effective fattening methods;

- Lack of access to resources and decision making role of women farmers;
- Limited diet combination of cereals and pulse food habits;

➢ **Intervention areas**

- Introduction of shelf life improvement technologies;
- Introduction of post-harvest handling tools;
- Provision of trainings and awareness creation;

Tarmaber

➢ **Constraints**

- Limited diet combination habits;
- Lack of market linkage for horticultural products;
- Lack of diversified crop production;

➢ **Intervention areas**

- Provision of training and introduction of new technologies;
- Integration of small holder farmers with market actors depending on the production season;
- Introduction of different storage facilities to lengthen storage periods;

Bassonawerana

➢ **Constraints**

- Limited diet combination habits;
- Lack of seasonal market linkage for potato and carrot;
- Lack of mechanization tools for wheat and barley production;
- Lack of established learning watershed;
- Lack of training on different agricultural production;

➢ **Intervention areas**

- Provision of training and introduction of new technologies;
- Integration of small holder farmers with market actors depending on the production season;
- Introduction of different storage facilities to lengthen storage periods;

Siyadebirnawayu

➢ **Constraints**

- Low grain market of wheat;
- Lack of suitable harvester and thresher tools;
- Lack of capacity of DAs to use supportive devices like GPS and plot design;

➢ **Intervention areas**

- Conducting market study;
- Market linkage establishment and experience sharing on utilization of improved mechanized farms with similar agro ecologies;
- Provision of trainings how to use GPS, and how to design experimental plots;

Moretinajiru

- **Constraints**
  - Low grain market of wheat and sorghum;
  - Lack of suitable harvester and thresher tools;
  - Limited access to improved technologies for low land areas;
  - Lack of developed value chain guide lines for Common Interest Groups/ CIG;
- **Intervention areas**
  - Conducting market and value chain studies;
  - Market linkage establishment and experience sharing on the utilization of improved mechanized farms with similar agro ecologies;
  - Introduction and evaluation of available technologies in the low lands;

Minjarshenkora

- **Constraints**
  - Low grain market of wheat and sorghum;
  - Lack of suitable harvester and thresher tools;
  - Limited access to improved technologies for low land areas;
  - Lack of developed value chain guide lines for CIG;
- **Intervention areas**
  - Conducting market and value chain studies;
  - Market linkage establishment and experience sharing on utilization of improved mechanized farms with similar agro ecologies;
  - Introduction and evaluation of available technologies in the low lands;

3.1.8. Recommendations and research interventions

The overall socioeconomics constraints regarding farming system, knowledge management, marketing, input and financial systems, livelihood systems, household economy and cross-cutting issues of nutrition, gender and climate smart agriculture in AGP-II woredas of North Shewa Zone of Amhara Region are more or less similar and needs similar interventions without some specific area. Hence, the summary of prioritized problems, the screening of the proposed solutions and possible intervention options are listed in the following table.

Table 2 Socioeconomics problems, screening options and intervention areas

S.No	Prioritized problems	Screening options	Interventions	Interventions areas
1	Lack of suitable improved farm tools	Technology	Demonstration of available technologies	All areas
2	High amount of post-harvest lose on onion, tomato, potato and sorghum	Awareness	Training and *mobilization*	Antsokiagemiza, *Efaratanagdim*, Kewet and Bassonawerana
3	Low market access for horticultural crops during peak harvest	Market linkage	Integrate the producers with high market areas	Antsokiagemiza, Efaratanagdim, Kewet and Bassonawerana
4	High market price variability from place to place for consumable commodities	Information	Conducting market study	Efaratanagdim,
5	High brokers intervention on grain marketing	Policy and making linkage	Conducting survey and identify the causes	Efaratanagdim, Kewet
6	Low training access for developing skills	Training	Organized training	Siyadebirnawayu, Moretinajiru, Tarmaber
S.No	***Prioritized problems***	**Screening options**	***Interventions***	**Interventions areas**
7	Limited access on technology choices	Intervention	Introduction of different technologies	Antsokiagemiza, Tarmaber, Kewet
8	Limited access and control on household resources for women	Information	Conduct gender related survey study	All areas
9	Limited access of sufficient nutrition availability	Awareness	Organize training and technology demonstration	All areas
S.No	***Prioritized problems***	**Screening options**	***Interventions***	**Interventions areas**
10	Low level of value chain guidelines for CIG	Information	Conducting value chain study on CIG areas	Moretinajiru, Bassonawerana, Tarmaber, Minjar shenkora

S.No	Prioritized problems	Screening options	Interventions	Interventions areas
11	Absence of market study information on wheat and sorghum	Information	Conducting market study on wheat and sorghum	Moretinajiru, Siyadebirnawayu, Minjareshekora
12	Absence of learning watershed and area closure management	Awareness	Organize training experience sharing	Tarmaber, Kewet and Bassonawerana
13	Absence of effective fattening practices for cattle	Technology	Demonstration and evaluation	Kewet, Antsokiagemiza

3.2. Crop Production and Management

3.2.1. Crop production

Cropping systems

In North Shewa AGP woredas about 24, 622 ha of land was covered with *belg*, each woreda covers from 215 ha to 9,061 ha of land. Table 3 shows that Moretinajiru and Minjarshenkora are the only two AGP woredas that do not have farm lands covered with belg. On the other hand, a total of 215, 359 ha of land in the North Shewa AGP II woredas are covered during the main cropping season. Furrow, drip, cannel, motor pump and ponds are among the modern irrigation systems that the AGP woredas are practicing. However, the woredas mainly follow traditional (flooding) irrigation system.

Table 3.Cropping Systems of the Eight AGP Woredas of North Shewa

Zone	Woreda	Cropping System		Irrigation	
		Belg (ha)	Maher (ha)	Traditional	Modern
North Shewa	Siyadebrinawayu	215	21789	Flooding	Furrow
	Moretinajiru	-	33425	-	-
	Bassonaworana	2899	42828	Flooding	Furrow and drip
	Minjarshenkora	-	48803.3	Flooding	Furrow
	Tarmaber	9061	17818	Flooding	Furrow
	Kewet	1527	20424	Flooding	Furrow
	Efratanagidim	7864	16952	Flooding	Furrow
	Ansokiagemza	3056	13320	Flooding	Cannel
Total		24,622	215, 359		

Cropping pattern

- **Relay cropping**

From the North Shewa AGP II woredas relay cropping system is practiced only in Tarmaber woreda. In the lowland areas of Tarmaber farmers first plant maize and later at the tasseling stage they sow haricot bean. Mostly the farmers prefer this technic to use their farm land efficiently.

- **Multiple cropping**

Except at Siyadebrenawayu, at all of the lowland areas of AGP II woredas of North Shewa double cropping is very common. In these woredas the farmers may produce up to three times in a year and mainly carried out in the lowland areas of the woreda. Mostly the first and the second productions are done with the supply of irrigation and lastly they prepare their farm land for the main rainy season production and produce sorghum, tef, mung bean or any other crop. For example, at Ansokiagemza, Kewet, Efratanagidim and Moretinajiru using irrigation first they produce tef, onion, tomato or mung bean and during the main cropping season they produce chickpea, tef, sorghum or any other; at Tarmaber first they produce barley using belg rain and during the main rainy season they produce faba bean, field pea or any other; at Bassonaworana woreda using irrigation supplement mostly they produce horticultural crops like carrot, cabbage and potato and in the main rainy season they produce barley or any other crops.

- **Intercropping**

The result of the assessment showed that intercropping is a common practice in almost all of the AGP II woredas except in Bassonaworana. This cropping system is commonly applied in the lowland areas of each area. In most of these areas, intercropping is done as: sorghum is intercropped with mung bean, sesame, safflower and haricot bean; maize is intercropped with haricot bean, mung bean, onion and potato; and tef is intercropped with safflower and sun flower.

- **Mono cropping**

In the areas of Ansokiagemza, Kewet, Efratanagidim, Siyadebrinawayu and Minjarshenkora tef, wheat and sorghum are grown continually year after year as a mono crops. Mono cropping is experienced in the areas where crops are grown only under rain fed. The farmers may grow the same crop in the same areas continuously for two or three years and after that it changes to other cereal crops and/or pulse crops.

- **Crop rotation**

Rotation is also the other cropping system that the farmers of the entire AGP II woredas follow. However, the sequence of the rotation may differ from one woreda to the other depending on the agro-ecology. For example the trend of rotational sequences of the AGP II woreda is:

* Ansokiagemza: tef after mung bean and faba bean, sorghum after mung bean, wheat after faba bean;
* Kewet: tef, mung bean and then sorghum; tef, onion and then mung bean;

* Efratanagidim: wheat after faba bean and field pea; barley after faba bean and field pea; sorghum after mung bean; tef after mung bean;
* Tarmaber: mung bean after tef and sorghum, wheat and tef after faba bean and field pea;
* Siyadebrinawayu: tef and wheat after faba bean and lentil;
* Bassonaworana: wheat and tef after faba bean and field pea, barley after potato, faba bean and field pea;
* Minjarshenkora: tef and wheat after chickpea and lentil;
* Moretinajiru: mung bean after sorghum; wheat and tef after lentil, faba bean and chickpea;

➢ **Fallowing**

Some of the farmers at Ansokiagemza, Kewet, Efratana Gidim, Tarmaber, Siyadebrinawayu, Bassonaworana and Moretinajiru Moretinajiru make their farm lands out of production or cultivation for only one year; and in the next cropping season they cultivate those farm lands that were kept fallow. In these areas fallowing is mainly applied in relation to soil fertility. Fallowing is more common in the highlands of the study area.

3.2.2. Crop management

Soil Fertility Improvement: soil fertility improvement is one of the basic activities for all of the commodity crops in all of the AGP II woredas. In this regard, the type of fertilizers used, the amount and time of application may vary from area to area and even from farmer to farmer in the same area and the same crop (Table 4).

Table 4.Soil fertility improvements practices by crop types

No.	Crops	Ansokiagemza	Kewet	Efratanagidim	Tarmaber	Siyadebrinawayu	Bassonaworana	Minjarshenkora	Moretinajiru
1	Tef	NPS and Urea	NPS and Urea	NPS and Urea	NPS and Urea	NPS and urea	NPS and urea	NPS and Urea	NPS and urea
2	Wheat	NPS and Urea	NPS and Urea	NPS and Urea	NPS and Urea	NPS and urea	NPS and Urea	NPS and Urea	NPS and urea
3	Maize	NPS and Urea	NPS and Urea	NPS and Urea	NPS and Urea			Compost and Urea	.
4	Barley		NPS and Urea	NPS and Urea	NPS and Urea	NPS and urea	NPS and Urea		NPS and urea
5	Sorghum	NPS and Urea	NPS and Urea	NPS	NPS and Urea	NPS and urea	NPS and Urea	Urea	NPS and urea
6	Faba bean	Compost	NPS and bio fertilizer	NPS and bio fertilizers	NPS and bio fertilizer	NPS and bio fertilizers	Bio fertilizer	Bio fertilizer and compost	NPS and bio fertilizers
7	Chickpea		NPS and bio fertilizer		NPS and bio fertilizer	NPS and bio fertilizers	Bio fertilizer	Bio fertilizer and compost	NPS and bio fertilizers
8	Potato	NPS and Urea	Manure	NPS	Manure	NPS and Urea	NPS and Urea	Compost	NPS and Urea
9	Tomato	NPS and Urea	NPS and Urea	NPS and Urea	NPS and Urea	NPS and Urea	NPS and Urea	Compost	NPS and Urea
10	Onion	NPS and Urea	NPS and Urea	NPS and Urea	NPS and Urea	NPS and Urea	NPS and Urea	NPS and urea	NPS and Urea
11	Mango	Compost	Compost ad manure	Compost	Compost ad manure	Compost	Compost and manure	Compost	Compost
12	Banana	Compost	Compost and manure	Compost	Compost and manure	Compost	Compost	Compost	Compost
13	Coffee	Compost	Compost and manure	Compost	Compost and manure	Compost	Compost	Compost	Compost

3.2.3. Type and source of seed

On the hands of the farmers, all the AGP II commodity crops have their own local variety. The local variety and their names may or may not be different from location to location. The source of the local variety is from farmer to farmer seed exchange and from their parents;even if at each location the variability of the local variety of the commodity crops are very wide.

In the eight AGP II woredas thirteen different organizations are recorded as a source of seed for improved varieties of the selected AGP commodity crops. These sources of improved variety are Ministry of Agriculture, Srinka Agricultural Research Center (SARC), Cooperatives/unions, Debre Brihan Agricultural Research Center (DBARC), Agricultural Growth Program (AGP), Sustainable Land Management (SLM), market, world vision, Amhara Seed Enterprise, Eastern Africa Agricultural Productivity Project (EAAP), Kulumsa Agricultural Research Center (KARC), Debre Zeit Agricultural Research Center (DZARC) Melkasa Agricultural Research Center (MARC), and orthodox church. One organization may supply one or more crops. The improved varieties of some crops are obtained directly from the market, for example the source of the improved varieties of onion (Bombe red and Adama red) is market. The list of the improved varieties introduced to each AGP II word and their sources is clearly listed below in Appedix 2.

3.2.4. Method of plouging and planting methods

Farmers in Kewet, Efratanagidim and Ansokiagemza used some mechanization using contractual base for plowing. But, in all the areas the dominant one is traditional plowing method using pair of oxen. Both broad castings and row plantings are widely practiced in all the woredas and for all cereal and pulse crops. While for onion, potato, tomato and fruit crops row planting is more common. In Siyadebrinawayu, Moretinajiru and in some of Bassonaworana furrow is commonly used for drainage of wheat, barley, faba bean and chickpea plots.

- **Tillage Frequency**

Tillage frequency may vary depending on the crop type, weed intensity, soil type, cropping history of the farm and agro ecology. This helps to blend up the soil, make the soil fine and manageable; and expose the seeds of weeds to the sun. The frequency of tillage is very high for tef, onion and tomato (3–5 times), and then wheat, barley and potato may be cultivated 2 or 3 times. At Ansokiagemza they use minimum tillage for faba bean and chickpea (Table 5).

- **Seed Rate**

It is very clear that the seed rate of the crop depends mainly on the planting method; some of the farmers weather they use row planting or broadcasting the seed rate of the crops is similar (Table 5). In most of the areas, especially in the low lands of North Shewa farmers use more than double of the recommended seed rate. For tef the farmers used three to four folds of seed for a hectare of land at a time and/or using over sowing. That is because of pests and various environmental effects especially inefficient soil moisture at the first sowing. Therefore, at that time the farmers use more seed rate than

the recommended rate. On the other hand, farmers use above the recommended seed rate to get more biomass to feed their livestock ; this is evident in the case for other crops like sorghum because of the need for more biomass to use as a feed for their live animals farmers use above the recommended rate.

Table 5. Tillage frequency and seed rates by crop types

Crop type	Woreda											
	Ansokiagemza			Kewet			Efratanagidim			Tarmaber		
	Seed Rate (Kg/ha)		Tillage frequency	Seed Rate (Kg/ha)		Tillage frequency	Seed Rate (Kg/ha)		Tillage frequency	Seed Rate (Kg/ha)		Tillage frequency
	Row planting	Broad casting		Row planting	Broad casting		Row planting	Broad casting		Row planting	Broad casting	
Bread Wheat	120	125	4		150	3		125	2 - 3		150	3
Tef		8 - 10	3 - 5		25 – 30	4	5	15	3 - 4		7	5
Sorghum	6 - 7	15	3	10	20	2	12	30	3	15	20	3
Food barley	100	100	3		125	2		100	3		150	3
Maize	Above the recommendation	30	3	13	25	2	25		2 - 3	20	30	3
Faba bean	150	150	Minimum	200	170	1		200	1		150	2
Chickpea		100	Minimum		125	1		125	1		125	2
Potato	20,000			1800		2		400	2	200		5
Tomato	0.25– 0.3		4			3	0.7		3			
Onion	4		4 - 5			4	6		3 - 4			

Crop type	Woreda											
	Siyadebrinawayu			Bassonaworana			Minjarshenkora			Moretinajiru		
	Seed Rate (Kg/ha)		Tillage frequency	Seed Rate (Kg/ha)		Tillage frequency	Seed Rate (Kg/ha)		Tillage frequency	Seed Rate (Kg/ha)		Tillage frequency
	Row planting	Broad casting		Row planting	Broad casting		Row planting	Broad casting		Row planting	Broad casting	
Bread Wheat	150	150	2	200	200	3		100	2	150-200	200	2-3
Tef		30	3		25	4		15	4		7	3-5
Sorghum	15	15	1	15	30	2	12	15	3	15	20	2
Food barley		125	2		150	3		110	3			
Maize				13			30		3			
Faba bean		200	2	200	250	2		150	2	150		2
Chickpea		175	2		200	1		120	3	125		2
Potato	20,000		2	2000		3	unknown		4			
Tomato	unknown		3	0.15		4	unknown		2 - 3			
Onion	unknown		2	4		4	unknown		3 - 5			

3.2.5. Pest management practices in the study areas

Farmers in Ansokiagemza woreda used insecticides (Endoselfan and Dimethoate), fungicides (Mancozeb and Ridomil) for the control of insect pests and diseases, respectively. Hand weeding is a very common practice and herbicides *i.e.* 2, 4-D and Pallas as a weed management option. Farmers in Kewet were using insecticides (Selecron, Dimethoate, Helerat, agro-lambacine, Endosulfan and Malathion) as a measure of insect pest management, fungicides (Mancozeb and Ridomil) as a control of diseases and herbicides (Granstar, 2, 4-D and Pallas) as weed management.

Farmers in Efratanagidim used insecticides (Dimethoate, Helerat, Selecron and mixed) for the management of insect pests; fungicides (Mancozeb and Ridomil) as diseases management option and herbicide; 2, 4-D for the control of weeds. Farmers of Tarmaber woreda used insecticides (Endosulfan, Selecron and Dimethoate), fungicides (Ridomil and mancozeb) and herbicide (2, 4-D) for the management of insect pests, diseases and weeds, respectively.

Farmers of Siyadebrinawayu woreda used insecticides (Dimethoate and Helerat) for the control of insect pests, fungicides (Mancozeb and Bayleton) as disease management measures and hand weeding and herbicides (Pallas, roundup and 2-4D) as weed management measures. Farmers in Bassonaworana woreda used insecticides (Sevin, Malathion, Roger and Dimethoate) fungicides (Tilt, Ridomil, Mancozeb and bayleton) and herbicides (2-4D and Pallas) for the control of insect pests, diseases and weeds, respectively. Farmers of Minjarshenkora used insecticides (Helerat, Karate, Tracer, Malathion and Diazinone) for the control of insect pests, fungicides (Ridomil, mancozeb, tilt, bayleton and Rex Duo) for the management of diseases and herbicides (2-4D, Pallas and topic) as weed management measures. Farmers in Moretinajiru woreda used insecticides (Dimethoate and Helerat) for the control of insect pests, fungicides (Mancozeb and Bayleton) as disease management measures and hand weeding and herbicides (Pallas, roundup and 2-4D) as weed management measures.

3.2.6. Identified major pests in the study area

- **Weed**

Weed is among the major crop production constraints in all the woredas. To control this problem, hand weeding is widely practiced. In the high land areas of North Shewa AGP II woredas *Xanthium strumarium L..Phalaris Paradoxa L.,Cyprus rotundus L..Trifolium rueppellianum.Polygonum nepalense Meisn, Striga hermonthica, partinium hysterophorus L., Guizotia scabra (Vis.) Chiov,Cynodon nlemfuenssis vanderyst, Avena fatua L., Echinocloa colona (L.) Link, Commelina benghalensis, L., Bromus pestinatum Thunb* and *Orobanche minor smith* are widely established. Especially *partinium hysterophorus L., Cyprus rotundus L.,* and *Striga hermonthica* at Ansokiagemza, Efratanagidim and Kewet are important weeds for crop production. On the contrary in the highlands of the area *Anagallis aruense, Phalaris Paradoxa L.Avena Fatua L.Phalaris Paradoxa L., Cyprus rotundus L., Guizotia scabra (Vis.) Chiov, Anagallis aruense, Argemone Mexicana L. gxanthium Strumarium* are serious weeds that affect the productivity of crops. In these areas farmers mostly use hand weeding and chemicals like Palas, 2-4D and topic.

❖ **Insect pest**

In the eight North Shewa AGP II woredas different insect pests are recorded as constraints for crop production and productivity. Stock borer and ball worm are common problems of all the woredas and shoot fly on tef is also a problem for all the woredas except in Kewet. For the rest insects, key yatef til and cut worm in Ansokiagemza, Minjarshenkora and Efratanagidim; Aphid in Ansokiagemza, Kewet, Tarmaber, Bassonaworana, Minjarshenkora and Moretinajiru; Army worm in Kewet; Meage in Kewet and Moretinajiru, Walo bush cricket in Efratanagidim; and shoot fly in Minjarshenkora are very serious problems for crop production.

❖ **Disease**

Disease is one of the serious problems in both the lowland and the highland areas of North Shewa, it may cause up to 100% yield loss. In the low land areas smut on sorghum, anthracnose on mango, powdery mildew on onion and tomato, wilt on tomato and root rot and purple blotch on tomato as well as onion are very common crop production problems. In the highlands of North Shewa, head, leaf and stripe rust on wheat and barley, faba bean gall, chocolate spot and root rot on faba bean, root rot and wilt on chickpea and early blight on potato are the causes for lose of crop production. For some of the diseases in some of the area like root rot on chickpea, smut on sorghum, blight on tomato, wilt and coffee berry disease on coffee, anthracnose and powdery mildew on mango and banana, farmers do not use any control measure. However, redomil, mancozeb, bilaton, tilt and redox are among the chemicals that farmers mostly used to control diseases in addition to the cultural control measures like drainage for root rot of faba bean and chickpea. Crop production constraints of the AGP II woredas of North Shewa zone for the fourteen selected commodity crops are mentioned (Appendix 4).

3.2.7. Harvesting and post harvesting techniques and transportation

➢ **Harvesting**

Most of the time, harvesting was performed traditionally or manually by the use of sickles to mow crops and threshing by trampling a group of animals upon it. In some cases, farmers at Minjarshenkora Woreda used combined harvesters for wheat.

➢ **Post harvesting**

Transportation: Farmers in the highland area used donkey and horse as a transport option for grain crops and potato, and in the lowland areas camel replaces the tasks of horses. For tomato, onion and mango most of the time they used camels but to some extent there is car access, wholesaler buy their products directly from the farm.

Storage types and duration of storage: Farmers consider insect infestation as the most important storage problems for grain crops and they use traditional skills to cope up with these problems. *Estimates of postharvest storage time were derived for each crop and for each woreda (Table 6).* Farmers use diverse methods and type of facilities to store grain crops such as store house (Gotera, which made of mud), underground pits and sacks. Most of the grain crops were stored from 6 to 12 months using store house, underground pits, and sacks. Mostly, the grain crops were either sold or

used as seed or used as home consumables within the storage time. Moreover, the farmers treat cereal and pulse crops with storage insecticides (Sulphonyl). On the other hand, due to unavailability of technologies to extend storage time, horticultural crops because of their short shelf life potato, tomato, onion, mango, banana and coffee were sold immediately after harvesting.

Table 6. Duration of storage in the study area by crop type

Commodity crops	Ansokia gemza	Kewet	Efratana gidim	Tarmaber	Siyadebri nawayu	Bassona worana	Minjar Shenkora	Moretinajiru
Bread wheat	1 year	1 year	1 year	> 1 year	1 year	1 year	> 1 year	1 year
Tef	1 year	1 year	1 year	1 year	1 year	1 year	> 1 year	1 year
Sorghum	1 year	1 year	2 year	2 year	3 year	1 year	> 1 year	6 month
Food barley	1 year	1 year	1 year	> 1 year	1 year	1 year	> 1 year	
Maize	-	_	_	> 1 year	-		-	
Faba Bean	1 year	3 year	1 year	> 1 year	1 year	1 year	6-12 months	1 year
Chickpea	1year	1 year	1 year	> 1 year	1 year	1 year	6-12 months	1 year

3.2.8. Major crop production problems per Woreda

- **Siyadebrinawayu**

- Faba bean chocolate spot and faba bean gall disease;
- Lackof disease resistant faba bean varieties;
- Tef shoot fly;
- Lack of harvesting and threshing machineries;
- Limitation on testing and demonstrating new tef, wheat, faba bean and chickpea technologies on the FTC sites;
- Limitation on testing the new fertilizers like NPS on the FTCs before disseminating them to the farmers;
- Lack of access to improved varieties like early maturing wheat, barley (frost is a problem), onion, potato, sorghum and tef for the lowland areas;
- Time of NPS and urea application for tef;
- Fertilizer rate (application of over the recommended rate is a problem) for wheat;
- There is soil variability in the area, so that it is better to test the soil in relation to Gasash for wheat.
- Frost tolerant wheat and barley variety;
- Potato wilt and blight;

- **Moretinajiru**

- Access to new onion varieties (for irrigation and disease resistance);

- Time and rate of fertilizer (NPS and urea) application for the lowland areas;
- Techniques and time of chemical application (herbicide and insecticide);
- Inefficiency of the available chemicals (better to test the newly introduced chemicals in the research center);
- Tef shoot fly;
- Unavailability of chemicals for stock borer and the available chemicals are not that much effective;
- Shortage of adaptable chickpea and faba bean variety;
- Unavailability of improved varieties for the low land areas especially on sorghum and tef;
- Lack of recommended tillage frequency for the high land areas (for both under dry and rainy condition);
- Survey for wheat drying to verify either the problem is due to Gasash or nutrient deficiency;
- Unavailability of adaptable improved banana variety;
- Problems on harvesting and threshing (access to harvester and thresher machinery);
- Without testing their adaptability some of the crop varieties are disseminated to the farmers (by unions and MOA); finally due to the low performance farmers are reluctant to accept the introduced varieties. Therefore, it is better for the research centres to test their adaptability and approve them forthwith;

  - **Bassonaworana**

- Soil acidity;
- Rust on wheat (resistance variety);
- Aphid for most of horticultural crops;
- Lack of improved faba bean varieties resistant to faba bean gall, root rot, chocolate spot and water lodging;
- Unavailability and inaccessibility of early maturing crop varieties;
- Lack of tef row planter;
- Lack of information on time, rate and method of chemical application, especially for faba bean gall disease and rust disease for wheat;
- Frost on faba bean, barley and wheat;

  - **Minjarshenkora woreda**

- Lack of drought resistant variety, especially sorghum, tef and wheat;
- Lackof tef and wheat row planter;
- Resistant variety or chemicals to control chickpea root rot;
- Harvesting and threshing machineries;
- Replacement of the existing varieties (Ararti chickpea);
- Wheat yellow rust;
- *Parthinioum and walo* weed;
- Absence of wheat and tef seed rate recommendations for black and brown soils;
- Very low onion productivity and lack of access to improved onion variety;
- Efficiency of chemicals to control tef shoot fly and key tef tile;

- Unavilability of improved onion and tomato variety for irrigation areas;
- Poor quality of kabuli type chickpea (under seed size);

➢ **Tarmaber**

- Faba bean chocolate spot;
- Faba bean gall disease;
- Yellow rust on wheat;
- Aphids;
- Access to improved variety for all AGP II commodity crops;
- Tef shoot fly;
- Mango anthracnose;

➢ **Kewet**

- Onion leaf miner;
- Faba bean chocolate spot and gall disease;
- Wheat yellow rust;
- Tef planter and thresher;
- White scale on mango;
- Chemical residual effect from both the soil and crops (a lot of chemicals are applied for onion, even a mixture of chemicals are applied on a plot of land);
- Unavilability of adaptable and newly improved faba bean, chickpea, maize, wheat, food barley, sorghum, tef, onion, tomato, potato, mango and banana technologies;
- Sorghum beetles and stock borer;
- Chemical registration and quarantine;
- Unavailability recommendation on onion spacing;

➢ **Efratana Gidim**

- Chocolate spot and faba bean gall disease;
- Parthinioum (congress weed);
- Unknown worm (in Amharic *Yameret wosfat*);
- Anthracnose and downy mildew on mango;
- Genetic erosion on local onion variety;
- Shortage of post-harvest handling techniques of onion and tomato;
- Lack of access to improved technologies (varieties);

➢ **Ansokiagemza woreda**

- Unavailability of recommended rate and time of fertilizer application on the low land tef;
- Lack of striga resistant sorghum varieties;
- Unknown worm (*yameret Wosfat*), it makes the soil out of production;
- Unavailability and inadequate improved varieties of different crops;
- Low response of fertilizer application on tef;
- Post-harvest loss of sorghum because of weevil;
- Awareness on integrated pest management (IPM);
- Awareness on the techniques of chemical application (safety);

- Tef row planter;
- Partenium weed;
- Tomato disease (drying and rotting of fruits);
- Mediterranean fruit fly on mango;
- Lack of early maturing varieties of different horticultural crops;

3.2.9. Crop technology constraint

❖ **Access to improved crop varieties**

Improved variety is one of the greatest opportunities to increase crop efficiency; without improved variety farmers could lose up to hundred percent yield due to adverse biotic and abiotic factors. Crop varieties are improved for different purposes, like for frost, earliness, yield, disease and/or other qualitative and quantitative traits. In all North Shewa AGP II woredas access to improved variety is one of the major limitations to improve productivity. In Tarmaber, Ansokiagemza and Efratanagidim there are problems on accessibility to the improved varieties of all the AGP commodity crops. In Kewet and Minjarshenkora there are accessibility problem, even if the accessible varieties have problems on like quality, cost (too much expansive) and do not touch in to the farmers timely. Farmers in Siyadebrinawayu and Moretinajiru have problems to access improved varieties of tef, barley, faba bean, chickpea, sorghum, onion, potato and tomato. In Bassonaworana woreda there are problems on access of new variety of tef and sorghum from cereal crops, chickpea and faba bean from pulse crops, onion and tomato from horticultural crops and mango from fruit crops.

❖ **Improved agronomic practice**

Improved variety without improved agronomic practice is nothing to achieve a reasonable yield of any crop. Thus, applying of improved agronomic practice is important. From the improved agronomic practices the following are stated as a problem in each AGP woredas of North Shewa:

- Seed rate of tef in Tarmaber, Siyadebrinawayu, Bassonaworana and Kewet;
- Threshing date of wheat and barley which is in relation to the occurrence of belg rain in Tarmaber, and labor shortage and cost in Siyadebrinawayu and Moretinajiru;
- Seed rate of sorghum in Kewet, Efratanagidim and Bassonaworana (farmers do not use the recommended seed rate);
- Seed rate of onion and tomato in Ansokiagemza, Kewet, Bassonaworana and Efratanagidim;
- Seed rate of potato in Kewet and Efratanagidim;
- Seed rate of wheat in Minjarshenkora and Bassonaworana;
- Seed rate of faba bean and chickpea in Bassonaworana;
- Fertilizer rate for sorghum in Minjarshenkora, the farmers only used urea at the rate of 50 *Kg/ha*;
- Fertilizer rate of all the AGP II commodity crops in Bassonaworana, the farmers apply insufficient rate for all crops;
- The farmers in Siyadebrinawayu and Bassonaworana have applied less rate of fertilizer for tomato, onion and potato;

❖ **Post-harvest management**

In all the AGP areas of North Shewa harvesting is done traditionally using man power, in Moretinajiru, Siyadebrinawayu and Minjarshenkora harvesting is done by daily laborers and at this time the cost of harvesting is very high. Some of the farmers do not afford the cost and due to that unpredictable rain, crop damage may occur in the field. Similar to other crops, potato and mango are harvested traditionally at that moment potato tubers are cracked and yield loss may occur and for mango, the fruit is harvested by kicking the branches of the tree and cause wounds on the tree (that may cause disease). Ripening of tomato is irregular; this condition causes a problem on harvesting and consequently causes yield loss. After harvesti ng, farmers store cereal and pulse crops up to one year, if there is favorable storage conditions these crops may be stored for more years. One of the major storage problems for chickpea, wheat, faba bean, barley and sorghum are weevils. Weevils attack the grain in the store and cause storage loss of these grain crops. For horticultural and fruit crops there are perishability problem and there are a storage problem for potato.

3.2.10. Prioritizing problems, screening and possible interventions

➢ **Prioritized crop production problems**

- Faba bean gall and chocolate spot diseases in all faba bean growing areas of North Shewa;
- Lack of harvesting and threshing machineries this is mostly for wheat;
- Demonstration of the new technologies like recommended chemicals, varieties, agronomic practices and machineries;
- Lack of access to improved variety, this is for all AGP II commodity crops;
- Time and raterate of fertilizer application, in most of the low land areas their application is either based on blanket recommendation or below the recommendation, while in the highland areas of the woredas farmers used to apply out of the recommendation;
- Tef shoot fly;
- Ineffectiveness of the available chemicals;
- Technics (time, rate and methods) of chemical application;
- Lack of recommendation on spacing of onion ;
- Yellow, stripe and steam rust of wheat;
- Aphids for most horticultural crops;
- Frost on wheat, barley and faba bean;
- Seed raterate and method of sowing for tef and sorghum;
- Weeds like parthinioum, striga and lantana camara;
- Anthracnose, scald, scale and Mediterranean fruit fly on mango;
- Onion leaf minor;
- Residual effects of chemicals;
- Post-harvest handling techniques on onion, tomato, mango and banana;
- Post-harvest loss due to weevil;

➢ **Screening of Prioritized Crop Production Problems and the Possible Interventions**

The required options, interventions for the prioritized problems in the selected intervention AGP II areas of North Shewa are clearly listed below on (Table 7).

Table 7.Options and interventions for the prioritized constraints

No.	Prioritized Problems	Options	Intervention	Intervention Areas
1	Faba bean gall and chocolate spot in all faba bean growing areas of north shoa	Improved varieties, agronomic practices and recommended chemicals	Evaluation, Demonstration, pre scaling up,	High land areas of the AGP Woredas
2	Harvesting and threshing machineries this is mostly for wheat	Improved mechanizations like combine harvester	Demonstration with the collaboration of private sectors and unions	Moretina Jiru, Siyadebrinawayu and Minjar Shenkora
3	Access to improved variety, this is for all AGP II commodity crops	Improved and adaptable varieties	Evaluation, adaptation. demonstration,	For all woredas and all commodity crops
4	Time and rate of fertilizer application for all commodity crops	Recommended fertilizer rate and time of application	Evaluation and demonstration,	For all woredas and all commodity crops
5	Low response of fertilizer application on the of production tef	-	Evaluation and verification	Low land areas of the AGP II woredas
6	Tef shoot fly	Chemicals and different management options	Verification, demonstration and pre scaling	Both in the low lands and high lands
7	Technics of chemical application and effectiveness of the available chemicals	Recommended rate, method and time of chemical application, skills on chemical application	Awareness creation on the use of chemicals. Verification of the available chemicals, demonstration	All the Woredas
8	Onion spacing	Recommended row spacing	Demonstration	Low land areas of the area
9	Yellow, stripe and steam rust of wheat	Resistant variety and chemicals	Evaluation, demonstration and pre scaling up of genotypes and demonstration of chemicals	High land areas of the area
10	Aphids for most	Chemicals,	Evaluation and	All the Woreda s

No.	Prioritized Problems	Options	Intervention	Intervention Areas
	horticultural crops	biological and cultural control measures	verification of different chemical options	
11	Frost on wheat, barley and faba bean	Sowing date adjustment and early maturing varieties (escaping mechanisms)	Evaluation and demonstration of early maturing genotypes and varieties as well as adjusting sowing date	Highland areas
12	Seed rate and method of sowing for tef and sorghum	Recommended seed rate and method of sowing	Demonstration of the recommended seed rate	Low lands of the area
13	Weeds like Parthinioum, striga and lantana camara	Chemicals, cultural practices and awareness creation on the effect and control measures	Demonstrating IPM	Low land areas
14	Anthracnose, scald, scale and Medetranian fruit fly on mango	Chemicals, resistance variety, cultural practice	Survey and evaluationof different control options	Low land areas
15	Onion leaf minor	Chemicals, agronomic practices and management options	Survey and evaluation of different control options	Low land areas
16	Residual effects of chemicals	chemical option	Demonstrate appropriate chemicals	Low land areas
17	Post-harvest handling techniques on onion, tomato, mango and banana	Agroindustry, improved handling techniques, improved varieties that have long shelf life	Linkage with agro industries, finding for different handling option and accessing varieties having long shelf life	Low land areas
18	post-harvest loss due to weevil	Chemicals, cultural practices, management options and storage facility	Evaluating for different options for control like chemicals, demonstration of storage materials.	All the Woredas

3.2.11. Recommendation and research interventions

3.2.11.1. Crop breeding activities

- Adaptation and demonstration of faba bean gall disease resistant varieties;
- Adaptation and demonstration of faba bean chocolate spot resistant varieties;
- Evaluation of faba bean genotypes with the interaction of environmental effects for faba bean gall disease;
- Introduction and demonstration of different farm machineries (Combine harvester) in the collaboration with different cooperatives and non-governmental organizations;
- Evaluating and verifying different genotypes of all AGP II commodity crops for all AGP woredas;
- Test the adaptability of released varieties of all the AGP II commodity crops for AGP II woredas;
- Test the adaptability of stripe, stem and yellow rust resistant bread wheat varieties for the North Shewa AGP II Woredas;
- Develop early maturing barley, wheat and faba bean varieties for the control of production loss due to frost damage;
- Develop *Striga hermonthica* resistant sorghum and maize varieties;
- Test the adaptability of different *Striga hermonthica* resistant sorghum varieties; and demonstrate the recommended varieties;

3.2.11.2. Agronomy activities

- Demonstrate the rate, type and time of fertilizer application;
- Evaluate, recommend and demonstrate the rate, type and time of fertilizer application for those crops that do not have recommendations;
- Demonstrate the recommended spacing;
- Evaluate and recommend the sowing date of barley, wheat and faba bean for the control of production loss due to frost damage;
- Demonstrate the recommended seed rate and row spacing on the low lad areas of North Shewa;

3.2.11.3. Crop protection activities

- Evaluating different chemicals for faba bean gall disease;
- Evaluating different chemicals for faba bean chocolate spot disease;
- Demonstrate different verified chemicals for faba bean gall disease;
- Evaluating different management options for the control of faba bean gall disease;
- Demonstrate different verified chemicals for faba bean chocolate spot disease;
- Evaluate different chemicals and other management options for the control of tef shoot fly in all the AGP-II Woredas;
- Demonstration and awareness creation on the use of chemicals;

- Evaluation of different chemicals for the control of yellow, stripe and stem rust of bread wheat;
- Evaluate different chemicals and management options for the control of aphids on horticultural crops;
- Demonstrate the recommended control options on the control of aphids on horticultural crops;
- Assess the seniority of *Striga hermonthica*, parthinioum and lantana camara and evaluate different control options;
- Assess the seniority scald, scale, anthracnose, and medetranian fruit fly on mango and their importance;
- Evaluate different mango varieties for scald, scale, anthracnose, and mediterranean fruit fly; as well as for different management options to control the raised problems;
- Evaluate different management options for onion leaf minor and demonstrate the recommended technologies to the farmer;
- Demonstrate the chemicals and fill the knowledge gap on the cause of weevil, important environments for the occurrence of the pest, utilization of chemicals;

Development Interventions

- Demonstration of the recommended crop varieties based on the agro ecology on FTCs;
- Create an access on improved and recommended seeds of different crop varieties to the farmer;
- Demonstrate all the recommended crop management practices on FTCs;
- Awareness creation on the improved crop management practices;
- Demonstrate different recommended pest management options;
- Awareness creation on the rate, time and the safest method of pesticide application to the farmers;

3.3. Livestock Production and Management

3.3.1. Livestock types and breeds

In all AGP woredas, the source of cattle cross breeds (Holstein Friesian and Jersey) of the study areas were generally Bureau of Agriculture (BOA) and neighbour farmers, whereas poultry breed is obtained from Kombolcha Poultry Ranch. In most of the woredas there is a high shortage of improved breeds of cattle and poultry. The major dairy cattle cross breeds of the study areas are Holstein Friesian and Jersey, Kokoek for poultry, Dorper and Awassi for sheep, Boer for goat and in case of local breeds there are Adal, Minjar, and Menz (Table 8).

Table 8. Livestock types in AGP woredas

Woreda	Dairy		Poultry		Sheep			Goat		
	Local	Cross	Local	Exotic	Local	Cross	Exotic	Local	Cross	Exotic
Antsokia	X		X	X	X	X		X		
Efratanagidim	X	X	X	X	X	X	X	X	X	X
Basonawarana	X	X	X	X	X	X	X	X	X	X
Minjarshenkora	X	X	X		X			X		
Siyadebirnawayo	X	X	X	X	X	X		X		
Tarmaber	X	X	X	X	X			X		
Moretnajiru	X	X	X	X	X			X		
Kewet	X	X	X	X	X	X		X	X	X

3.3.2. Livestock population and productivity

Efratanagidim, kewet and Basonawerana woredas possessed thousands of local breeds of cattle with a population number 116,222.00, 87,382.00 and 82,321.00, respectively followed by Tarmaber 59,289.00, Siyadebirnawayo 52,040.00 and Moretinajiru 51,922.00 whereas the result of this survey showed high number of cross breed of cattle in Basonawerana 29,607.00 Siyadebirnawayo 7,827.00 and Moretinajiru 4,950. Out of the eight study woredas Basonawerana 167,476.00, Efratanagidim 141,247.00 and Minjarshenkora 136,329.00 kept high population of local breeds of poultry; on the other hand Siyadebirnawayo and Tarmaber had high exotic breeds of poultry 21,156.00 and 18,512.00 correspondingly, followed by Efratanagidim 14,740.00 and Moretinajiru 11,149.00. When we come to sheep population Basonawerana (133,901.00) Siyadebirnawayo (90,190.00) and Efratanagidim (66,478.00) kept high number of local breeds whereas only four woredas have sheep cross breed Efratanagidim, kewet Moretinajiru and Siyadebirnawayo. High number of goat was obtained from Kewet i.e. 128, 564.00, Efratanagidim 65,042.00, followed by Minjarshenkora 54,408.00 (table 12). The potential resources in all AGP selected woredas are livestock production (milk, meat egg and honey) and the productivity at all is not satisfactory.

3.3.3. Livestock production system

The husbandry system was broadly divided in three based upon housing condition, handling facilities, general hygienic condition in the farm yard and feeding and watering troughs. Hence, the major production system is extensive in the highland and semi-intensive and intensive in the lowland of North Shewa woredas in case of poultry the production system is intensive in most of the study woredas. In woredas where the production systems are extensive there are intensive and semi-intensive production systems for especial events like fattening and in dairying.

3.3.4. Forage types and feed system

The utilization of feed in each woreda seems to be similar (Table 9); its production is not satisfactory at all and there are shortages of improved legumes and grasses in all the study areas. The reason is that farmers prefer to supplement more to dairy cows and sheep or fattening bulls. Due to high shortage of improved feeds, their availability is very low in all woredas.

Table 9. Forage type per woreda

Woreda	Forage type			
	Local grass	Local browse	Improved grass	Improved legume
Antsokia	Natural pasture	Thyme (tosigni)	Elephant grass	Sasbania, cowpea, pigeon-pea and alfalfa
Efratana gidim	Natural pasture	-		
Basona werana	Natural pasture	-	Elephant grass,	Sasbania, oat, vetch and tree-lucerne
Minjarshenkora	Natural pasture	-	Elephant grass	Sasbania, tree-lucerne
Siyadebirna wayo	Natural pasture	-	-	Sasbania, oat, vetch and tree-lucerne
Tarma Ber	Natural pasture			Sasbania, acacia, vetch and tree-lucerne
Moretna Jiru	Natural pasture		Elephant grass	Cowpea, pigeon-pea, vetch, Sasbania, and tree-lucerne
Kewet	Natural pasture	Wendmiye, kesele and mezazigni	Elephant grass	Sasbania

3.3.5. Animal feeding system by production purpose and season

The findings of the survey study reveal that farmers use free grazing, cut and carry, supplemental feeding like green feed, industrial by product, grain and atela to all types of production purposes, therefore no difference in the feeding system for meat and milk production they are habituated to give supplemental feeds using feed trough to their animals for all production purposes except poultry which are provided with grain and crop product.

Major feed resource in dry and wet season is almost similar in all woredas except some woredas (Siyadebirnawayo and Moretinajiru) where crop weeds are used as a feed in the wet season. The feeding system encompasses the animals grazing on pasture, but provided with minor feed supplements (roughage, and brewery residues) and the other with adequate supply of roughage supplemented with wheat bran, *nug* cake, cotton seed cake, brewery residues and improved grass and legume etc. In the low land and middle altitude areas of Antsokiagemza woreda the farmers are accustomed to hey production. Water sources in both seasons are ponds, rivers and spring in some parts. The house is not separated unless for special activity like fattening. The breeding management at all is uncontrolled except those who are accustomed to use the AI service but for insignificant population size (Table 10).

Table 10. Feed resources

	Siyadebirna wayo		Tarma ber		Moretna Jiru		Kewet	
Feed resource	**List**	**Type of animal**	**List**	**Type of animal**	**List**	**Type of animal**	**List**	**Type of animal**
Private grazing	Local grass	Cattle, sheep, goat, equine			Local grass	Cattle, equines and small ruminant		
Communal Grazing			Local grass	Cattle, equines and small ruminant	Local grass	Cattle, equines and small ruminant	Local grass	Cattle, sheep, goat, equines
Hay	Local grass	Cattle and small ruminant	Local grass	Cattle and small ruminant			Local grass	Cattle, small ruminant and equines
Improved forage	Sasbania, tree-lucerne, vetch and oat	Cattle and small ruminant	Sasbania, tree-lucerne, acacia, vetch and oat	Cattle and small ruminant	Cowpea, Pigeon-pea, vetch, Sasbania, and tree-lucerne	Cattle, and small ruminant	Cowpea, Pigeon-pea and elephant grass	Cattle
Browse trees and shrubs	Sasbania, tree-lucerne, acacia, embuach o, dedeho	small ruminant	Sasbania, tree-lucerne, acacia	small ruminant	Sasbania, and tree-lucerne	small ruminant	Wendmiye, keselc mezazigni and Sasbania	Sheep, goat and camel

	Siyadebirna wayo		Tarma ber		Moretna Jiru		Kewet	
Feed resource	**List**	**Type of animal**	**List**	**Type of animal**	**List**	**Type of animal**	**List**	**Type of animal**
	and kese							
Crop residue	Teff, wheat, barley , faba bean and guaya	Cattle, equines and small ruminant	Teff, sorghum, maize, wheat, barely, mung-bean	Cattle and small ruminant	Wheat, teff, lent, chickpea, beans	Dairy cattle and fattening animals	Teff, wheat, barley	Cattle, small ruminant and equines
Industrial byproduct	Nugcake, furshca, fagulo and atela	Dairy cattle and fattening animals	Nugcake, furshca, fagulo and atela	Dairy cattle and fattening animals	Nugcake, furshca, fagulo and atela	Dairy cattle and fattening animals	furshca, fagulo	Cattle, small ruminant and equines
Grain	Guaya, Misir and ater	For fattening	Guaya, Misir and ater	For fattening	Bean, teff, Guaya, Misir and ater	Dairy cattle and fattening animals	Bean, teff, Guaya, Misir and ater	Cattle, small ruminant and equines

	Antsokia		Efratanagidim		Basonawerana		Minjar	
Feed resource	**List**	**Type of animal**	**List**	**Type of animal**	**List**	**Type of animal**	**List**	**Type of animal**
Private grazing	Local grass	Cattle , sheep and goat, equines	Local grass	Cattle , sheep and goat, equines	-		-	-
Communal Grazing	Local grass	Cattle , sheep and goat, equines	-	-	Local grass	Cattle , sheep, equines	Local grass	Cattle, sheep, goat, equines
Hay	Local grass	Cattle , sheep and goat, equines	-	-	-	-	-	-
Improved forage	Elephant grass, Sasbania, luquinea and acacia	Cattle , sheep and goat	-	-	Elephant grass, and tree-lucerne	Cattle and fatten sheep	Elephant grass, Sasbania, tree-lucerne	Cattle, sheep, goat, equines
Browse trees and shrubs	Tosigni, Sasbania, and luquinea	sheep and goat	-	-	-		Acacia spp.	Goat and cattle

	Antsokia		Efratanagidim		Basonawerana		Minjar	
Feed resource	**List**	**Type of animal**	**List**	**Type of animal**	**List**	**Type of animal**	**List**	**Type of animal**
Crop residue	Maize, faba bean, pigion-pea, barley, sorghum, Selit and furshca	Cattle , sheep and goat, equines	Teff, sorghum, maize, wheat, barely, pea, bean, masho, soybean	Cattle, sheep, goat and equine	wheat, barely, faba bean vetch and tree-lucerne	Cattle , sheep, equines	Teff, barely, wheat, bean, misir and shinbura.	Cattle, sheep, goat, equines
Industrial byproduct	-	-	-	-	Concentrat e from traditional processors	Cattle , sheep, equines	Atela, fagulo, furshca and molasses.	Cattle and sheep fattening.
Grain	Sorghum, bean and teff	Poultry, dairy cattle	-	-	Wheat and Oat	For fattening (sheep, cattle)	Guaya and wheat.	Cattle and sheep fattening

3.3.6. Health management by animal type

The major health problem of the study AGP-II woredas are sheep and goat infectious diseases (pasteurellosis, foot rot, sheep and goat pox, and anthrax) CCPP were reported only from Minjer, Moretnajiru and Kewet and PPR were reported from Minjar woreda. Regarding internal and external parasite cases, liver fluke, nematodes, hydatidosis and oestrus ovis, menge, sheep kid, lung worm, orf and demodex were found out to be parasites in the majority of study areas, however among the internal parasites liver fluke is the highly prevalent parasitic agent mentioned in all the woredas except Minjarshenkora and Kewet. The reason for the high occurrence of fasciolicides in those woredas is that farmers do have the tradition of keeping their animals in marshy grazing lands. The inefficacy of the most currently available drugs (antibiotics and anthelmintic) were also reported by the respondents. Most of the cultural treatments (systems) are not known at all but the majority of the farmers use the modern health management system when their animals become sick. Lack of efficient medicament, inaccessibility of veterinary clinics and knowledge gap (the absence of refreshment courses for veterinarians especially in poultry diseases) were cited as major problem of all study woredas (Appendix 5).

Processing

All processing trends in the eight study woredas to process yogurt, cheese and butter is traditional. There are lack of modern agro-processing technologies, market linkage, transportation, information and high knowledge gap to improve the technology.

3.3.7. Livestock production constraints

Antsokiagemza

Dairy and poultry genetic constraints

- Lack of exotic/cross breed and access problem;
- Day old chick shortage;
- **Knowledge Gap-** estrus synchronization knowledge gap expressed as a lack of skill to identify cyclic cows by defining the presence of active corpusluteum (CL), gap of skill to examine the performance of reproductive organ (reproductive tract abnormalities), detecting pregnancy etc.;
- Lack of knowledge on day old chick management practices;
- **Institutional problem-**lack training to build the capacity of employees in reproduction (artificial insemination, identification of cyclic cows, examination of reproductive organ abnormalities etc) and animal health in terms of disease identification, prevention and control for cattle, sheep and goat and poultry;
- **Adaptability** – day old chick adaptability problem and environmental stress exposure problem in some breeds;
- **Productivity-** low productivity due to poor management practices;

Feeds constraints

- Lack of quality feeds;

- **Knowledge-** crop residue palatability evaluation and management skill gap, lack of skill in urea treatment;
- **Expensiveness-** unavailability of essential feeds due to high price;
- **Institutional**-lack of refreshment training on how to improve, manage and adopt high quality forages;
- There are problems to access improved forage seeds;
- Adaptability problem of improved forage based on the agro ecology of the woreda for all type of animals including honey bee;
- Low productivity as a result of poor handling (management);

Animal health constraints

- **Accessibility** problem to reach veterinary clinics (difficult to take sick animals from kebeles to woreda vet clinics or adjacent kebeles), absence of laboratories;
- **Knowledge-** low skill on all types of disease identification due to shortage of laboratory diagnosis practices and disease management knowledge gap;
- Lack of epidemiological disease investigation;
- **Institutional**-lack of acquaintance with highly equipped laboratory leading to poor disease diagnosis and erroneous results;
- Non existence of refreshment training;
- The use of inefficacy medicament, unauthorized (uncontrolled) private drug sellers, non existence of constant disease investigation, control and prevention program;

Constraints related to processing technologies and equipment

- Commonly used processing procedure is traditional due to **lack of new technologies** to process milk and milk products etc.;
- There are **transportation materials** problems to transport processed agricultural products;
- Lack of feed processing knowledge and management;
- Lack of **processing equipments** and materials;

Efratanagidim

Dairy and poultry constraint related to breed

- Problem of **access** to exotic and cross breed and absence of artificial insemination service, Day old chick shortage;
- **Knowledge gap-** the unsuccessful output of estrus synchronization resulted due to lack of skill to identify cyclic by defining the presence of active corpusluteum (CL), skill gap in examining the performance of reproductive organ (reproductive tract abnormalities), detecting pregnancy etc.;
- **Institutional problem-** capacity building in animal health in terms of disease identification, prevention and control and dairy production improvement;
- **Adaptability** - environmental stress exposure problem;
- **Productivity-** low productivity due to poor management practices;

Animal health constraints

- **Accessibility** problem to reach veterinary clinics (difficult to take sick animals from kebeles to woreda vet clinics or adjacent kebeles), absence of laboratories;
- **Knowledge-** low skill on all types of disease identification due to shortage of laboratory diagnosis practices and disease management knowledge gap, epidemiological disease investigation absence at all;
- **Institutional**-lack of acquaintance with highly equipped laboratory leading to the poor disease diagnosis findings, non existence of refreshment training, the use of inefficacy medicament, unauthorized (uncontrolled) private drug sellers, no existence of constant disease investigation, control and prevention program at the country level,

Constraints related with processing technologies and equipment

- Gap of modern processing technologies;
- Lack of improved transportation materials;
- Knowledge gap in terms of feed processing and management;
- Absence of processing equipment;

Basonawerana dairy and poultry genetic constraints

- **Problem of access to improved breeds:**
- Shortage of breed accessibility, day old chick shortage;
- **Knowledge gap-** Day old chick growth problem due to lack of proper management practices and skill and poultry disease identification problem, inefficacy of estrus synchronization practices as a result of high knowledge gap in identification of cyclic cow proper for estrus synchronization, lack of skill on identification of reproductive organs abnormalities, lack of knowledge and capacity on laboratory based bacterial disease identification;
  - **Adaptability-** the newly introduced breeds faced the problem of adjusting themselves to the local climate and management practice;
  - **Institutional-** capacity building of employee in reproduction (artificial insemination, identification of cyclic cows, examination of reproductive organ abnormalities etc) and animal health disease identification, prevention and control, apiculture and aquaculture technologies;

Feeds constraint

- Lack of **quality** feeds;
- **Knowledge-** crop residue palatability evaluation and crop residue management (how to treat Eg. Urea treatment and others) skill gap;
- **Expensiveness-** unavailability of essential feeds due to high price;
- **Institutional**-lack of training on nutritional quality improvement technologies. Lack of supplies like feed, water trough etc;
- Lack and access problem to quality improved forage seeds;
- **Knowledge-** low skill on improved forage expansion (development) and management;
- **Adaptability** problem of improved forage s based on the agro ecology of the woreda for all type of animals including honey bee;

- **Institutional-** no of refreshment training on how to improve, manage and adopt high quality forage;
- **Productivity-** low productivity as a result of poor handling (management);
- High price and low quality of commercial feeds;

Animal health constraints

- **Accessibility** problem to reach veterinary clinics (difficult to take sick animals from kebeles to woreda vet clinics or adjacent kebeles), absence of laboratories;
- **Knowledge-** low skill on all type of disease identification due to shortage to laboratory diagnosis practices and disease management knowledge gap, epidemiological disease investigation absence at all;
- **Institutional-**lack of acquaintance with highly equipped laboratory leading to poor disease diagnosis findings, non existence of refreshment training, the use of inefficacy medicament, unauthorized (uncontrolled) private drug sellers, no existence of constant disease investigation, control and prevention program at the country level;

Constraints related with processing technologies and equipment

- Commonly used processing procedure is traditional due to lack of new technologies to process milk and milk products etc.;
- There are transportation materials problems to transport processed agricultural products;
- Lack of feed processing knowledge and management;
- Lack of processing equipments and materials;

Feeds constraint

- Lack of quality feeds;
- **Knowledge-** crop residue palatability evaluation and crop residue management (how to treat Eg. Urea treatment and others) skill gap;
- **Expensiveness-** unavailability of essential feeds due to high price;
- **Institutional-**lack of training on nutritional quality improvement technologies;

Identified constraint related to forage

- Lack of accessibility, high price and low quality;
- **Knowledge gap-** low improved forage management practices, skill gap on how develop (expanses) them;
- **Institutional-**lack of refreshment training and capacity building on improved forage development and management;
- **Adaptability-** problem to adapt the local environment (exposed to the environmental stress);
- **Productivity-**low production due to low skill of management;

Animal health constraints

- **Accessibility** problem to reach veterinary clinics (difficult to take sick animals from kebeles to woreda vet clinics or adjacent kebeles), absence of laboratories;

- **Knowledge-** low skill on all type of disease identification due to shortage of laboratory diagnosis practices and disease management knowledge gap, epidemiological disease investigation absence at all;
- **Institutional-**lack of acquaintance with highly equipped laboratory leading to the poor disease diagnosis findings, non existence of refreshment training, the use inefficacy medicament, unauthorized (uncontrolled) privet drug sellers, no existence of constant disease investigation, control and prevention program at the country level;

Constraints related to processing technologies and equipment

- There is no modern technologies to process agricultural products;
- High knowledge gap to improve the technologies and feed management;
- Lack of improved transportation materials;
- Lack of **processing equipments** and materials;

Siyadebirnawayo dairy and poultry genetic constraints

- **Problem access to breed-** shortage of improved breeds, day old chick shortage;
- **Knowledge gap-** day old chick growth problem due to lack of proper management practices skill and poultry disease identification problem, inefficacy of estrus synchronization practices as a result of high knowledge gap in identification of cyclic cow proper for estrus synchronization, lack of skill on identification of reproductive organs abnormalities, lack of knowledge and capacity on laboratory based bacterial disease identification;
- **Adaptability-** the newly introduced breeds face the problem of adjusting themselves to the local climate and management practice;
- **Institutional-** capacity building of employees in reproduction (artificial insemination, identification of cyclic cows, examination of reproductive organ abnormalities etc) and animal health disease identification, prevention and control, apiculture and aquaculture technologies. budget shortage lack of refreshment training;

Feeds constraint

- Lack of **quality** feeds;
- **Knowledge-** crop residue palatability evaluation and crop residue management (how to treat Eg. Urea treatment and others) skill gap;
- **Expensiveness-** unavailability of essential feeds due to high price;
- **Institutional-**lack of training on nutritional quality improvement technologies. Lack of supplies like feed, water trough etc;

Identified constraint related with forage

- Access problem and lack of quality improved forage seeds;
- **Knowledge-** low skill on improved forage expansion (development) and management;
- **Adaptability** problem of improved forage based on the agro ecology of the woreda for all type of animals including honey bee;
- **Institutional-**no of refreshment training on how to improve, manage and adopt high quality forage;

- **Productivity**- low productivity as a result of poor handling (management); Price and quality constraints;

Animal health constraints

- **Accessibility** problem to reach veterinary clinics (difficult to take sick animals from kebeles to woreda vet clinics or adjacent kebeles), absence of laboratories;
- **Knowledge**- low skill on all types of disease identification due to shortage of laboratory diagnosis practices and disease management knowledge gap, epidemiological disease investigation absence at all;
- **Institutional**-lack of acquaintance with highly equipped laboratory leading to the poor disease diagnosis findings, nonexistence of refreshment training, the use of inefficacy medicament, unauthorized (uncontrolled) privet drug sellers, no existence of constant disease investigation, control and prevention program at the country level;

Constraints related to processing technologies and equipment

- Commonly used processing procedure is traditional due to lack of new technologies to process milk and milk products etc;
- There are transportation materials problems to transport processed agricultural products;
- Lack of feed processing knowledge and management;
- Lack of processing equipments and materials;

Tarmaber dairy and poultry constraint related to breeds

- Lack of exotic/cross breeds and problem to access, day old chick shortage;
- **knowledge gap**- estrus synchronization knowledge gap expressed as a lack of skill to identify cyclic by defining the presence of active corpus luteum (CL), gap of skill on examine the performance of reproductive organ (reproductive tract abnormalities), detecting pregnancy etc. lack of knowledge on day old chick management practices;
- **Institutional problem**- lack of capacity building training for employees in reproduction (artificial insemination, identification of cyclic cows, examination of reproductive organ abnormalities etc) and animal health in terms of disease identification, prevention and control for cattle, sheep and goat and poultry;
- **Adaptability** – day old chick adaptability problem and environmental stress exposure problem of some breeds;
- **Productivity**- low productivity due to poor management practices;

Feeds constraint

- Lack of **quality** feeds;
- ***Knowledge***- *crop residue palatability evaluation and crop residue management (pasture* management trend is not habitual but some insignificant numbers of farmer treat their crop residue by urea.) skill gap;
- **Expensiveness**- unavailability of essential feeds due to high price;
- **Institutional**-lack of training on nutritional quality improvement technologies;

Identified constraint related with forage

- **Access** problems and lack of quality of improved forage seeds;
- **Knowledge**- low skill on improved forage expansion (development) and management;
- **Adaptability** problem of improved forage based on the agro ecology of the woreda for all type of animals including honey bee;
- **Institutional**- no of refreshment training on how to improve, manage and adopt high quality forage;
- **Productivity**- low productivity as a result of poor handling (management);
- Price and quality constraints;

Animal health constraints

- **Accessibility** problem to reach veterinary clinics (difficult to take sick animals from kebeles to woreda vet clinics or adjacent kebeles), absence of laboratories;
- **Knowledge**- low skill on all type of disease identification due to shortage of laboratory diagnosis practices and disease management knowledge gap, epidemiological disease investigation absence at all;
- **Institutional**-lack of acquaints with highly equipped laboratory leading to the poor disease diagnosis findings, non existence of refreshment training, the use of inefficacy medicament, unauthorized (uncontrolled) privet drug sellers, no existence of constant disease investigation, control and prevention program at the country level;

Constraints related to processing technologies and equipment

- There are no modern technologies to process agricultural products;
- High knowledge gap to improve the technologies and feed management;
- Lack of improved transportation materials for the product and byproducts;
- Lack of processing equipments and materials;

Moretnajiru dairy and poultry genetic constraints

- **Problem access to breed**- shortage of improved breeds accessibility, day old chick shortage;
- **Knowledge gap**- day old chick growth problem due to lack of proper management practices skill and poultry disease identification problem, inefficacy of estrus synchronization practices as a result of high knowledge gap in identification of cyclic cow proper for estrus synchronization, lack of skill on identification of reproductive organs abnormalities, lack of knowledge and capacity on laboratory based bacterial disease identification;
- **Adaptability**- the newly introduced breeds face the problemof adjusting themselves to the local climate and management practices;
- **Institutional**- capacity building of employees in reproduction (artificial insemination, identification of cyclic cows, examination of reproductive organ abnormalities etc) and animal health disease identification, prevention and control, apiculture and aquaculture technologies, budget shortage lack of refreshment training;

Feeds constraint

- Lack of quality feeds;
- **Knowledge**- crop residue palatability evaluation and crop residue management (how to treat Eg. Urea treatment and others) skill gap;
- **Expensiveness**- unavailability of essential feeds due to high price;
- **Institutional**-lack of training on nutritional quality improvement technologies;

Identified constraint related to forage

- Lack of forage **accessibility**, high price and low quality;
- **Knowledge gap**- low improved forage management practices, skill gap on how to develop (expanses) them;
- **Institutional**-lack of refreshment training and capacity building on improved forage development and management;
- **Adaptability**- problem to adapt the local environment (exposed to the environmental stress);
- **Productivity**-low production due to low skill of management;

Animal health constraints

- **Accessibility** problem to reach veterinary clinics (difficult to take sick animals from kebeles to woreda vet clinics or adjacent kebeles), absence of laboratories;
- **Knowledge**- low skill on all type of disease identification due to shortage of laboratory diagnosis practices and disease management knowledge gap, epidemiological disease investigation absence at all;
- **Institutional**-lack of acquaintance with highly equipped laboratory leading to the poor disease diagnosis findings, non existence of refreshment training, the use of inefficacy medicament, unauthorized (uncontrolled) privet drug sellers, no existence of constant disease investigation, control and prevention program at the country level;

Constraints related to processing technologies and equipment

- Lack of new technologies to process milk and milk products;
- There are transportation materials problem to transport processed agricultural products;
- Lack of feed processing knowledge and management;
- Lack of processing equipments and materials;

Kewet dairy and poultry genetic constraints

- Lack of exotic/cross breed and problem to access, day old chick shortage;
- **Knowledge gap**- estrus synchronization knowledge gap expressed as a lack of skill to identify cyclic by defining the presence of active corpus luteum (CL), gap of skill on examine the performance of reproductive organ (reproductive tract abnormalities), detecting pregnancy etc. lack of knowledge on day old chick management practices;
- **Institutional problem**- building the capacity of employees in reproduction (artificial insemination, identification of cyclic cows, examination of reproductive organ abnormalities etc) and animal health in terms of disease identification, prevention and control for cattle, sheep and goat and poultry, budget and shortage of refreshment training;

- **Adaptability** – day old chick adaptability problem and environmental stress exposure problem of some breeds;
- **Productivity-** low productivity due to poor management practices;

Feeds constraint

- Lack of **quality** feeds and the problem to access;
- **Knowledge-** crop residue palatability evaluation and crop residue management (how to treat Eg. Urea treatment and others) skill gap, pasture management trend is not habitual but some insignificant numbers of farmer treat their crop residue by urea.
- **Expensiveness-** unavailability of essential feeds due to high price;
- **Institutional-**lack of training on nutritional quality improvement technologies;

Identified constraint related to forage

- Lack of accessibility, high price and low quality;
- **Knowledge gap-** low improved forage management practices, skill gap on how to develop (expanses) them;
- **Institutional-**lack of refreshment training and capacity building on improved forage development and management;
- **Adaptability-** problem to adapt the local environment (exposed to the environmental stress);
- **Productivity-**low production due to low skill of management;

Animal health constraints

- **Accessibility** problem to reach veterinary clinics (difficult to take sick animals from kebeles to woreda vet clinics or adjacent kebeles), absence of laboratories;
- **Knowledge-** low skill on all types of disease identification due to shortage of laboratory diagnosis practices and disease management knowledge gap, epidemiological disease investigation absence at all;
- **Institutional-**lack of acquaintance with highly equipped laboratory leading to the poor disease diagnosis findings, non existence of refreshment training, the use of inefficacy medicament, unauthorized (uncontrolled) privet drug sellers, no existence of constant disease investigation, control and prevention program at the country level;

Constraints related to processing technologies and equipment

- No modern processing technologies;
- Lack of improved transportation materials;
- Lack of feed processing knowledge and management;
- Lack of processing equipments and materials;

3.3.8. Prioritizing problems, screening options and interventions on livestock

Table 11. Breed related identified problems priority

Species	1st	2nd	3rd
Cattle	Feed shortage	AI efficiency	Mastitis, skin and hide
Sheep and goat	Feed shortage	Genetic improvement	Pasteurellosis, Fasciola
Poultry	Management (feed, health and housing)	Genetic improvement strategy / scheme	
Others (apiculture and aquaculture)	Introducing new technologies	Integrated production system	

Table 12. Prioritized problems, screening options and interventions on livestock production

Prioritized problems	Options	Interventions	Responsible bodies
Feed shortage	Development of improved forage, Evaluation of improved forage and adaptability problem (fodder-bit), Improved feed management practices, Pasture improvement	-Adaptation -Evaluation -Demonstration -Multiplication	Research and university
Low AI efficiency	Evaluation of different protocols	Survey (assess Mass synchronization efficacy problem), Evaluation different option of synchronization	Extension
Mastitis problem	Identification of the causal agent, develop and produce new effective medicament (antibiotic)	Bacteriological laboratory test for the identification of the causal pathogen, Identify option of control and prevention methods, AST test pattern evaluation and Development of new effective drug	Research and extension
Low quality of	High quality skin	Produce high quality skin	Research and

Prioritized problems	Options	Interventions	Responsible bodies
skin and hide	production, Skin disease identification	via selection, breeding and improved management, Skin disease identification, prevention and control	university
Small ruminant genetic improvement problem	Improved the local breed via selection, improved feeding strategies, Cross breeding, Improved Small ruminant production management system (feeding, housing and health)	Selection, cross breeding, Improvement of SR production package (feeding, housing and health), Adaptation, Demonstration and Multiplication	Research and extension
Ovine Pasteurellosis,	Bacteriology and Molecular laboratory accessibility	Bacteriology identification Strain identification by PCR (Polymerase Chain Reaction)	Research and university
Fasciolosis control strategies problems	Strategically control procedure and Effective anti-fasciolicides	Develop snail control strategies in marshy areas, Introduce or produce effective anthelmintic drugs, awareness creation on the control and prevention strategies of fasciolosis	Extension
Poultry Management (feed, health and housing) problems	Strategies for poultry adaptability and management	Environmental modification and use of improved management for poultry/ day old chick adaptability	Extension
Poultry Genetic improvement strategy / scheme problem	Local breed improvement and sustainability through improved technologies and Poultry disease identification problem	Selection of high yield local breed chicken, Develop high value poultry management practices, Poultry disease investigation (infectious, viral and parasitical diseases)	Research and university
Problems with	Develop apiculture and	Adaptation	University

Prioritized problems	Options	Interventions	Responsible bodies
Introducing new technologies of apiculture and aquaculture and Integrated production system	aquaculture technologies	Evaluation Demonstration Multiplication	

3.3.9. Recommendations and research interventions/proposals

Dairy

- Assessment of previous estrus synchronization to evaluate the efficacy problem;
- Evaluation and demonstration of different synchronization protocols to define conception rate of hormones assisted AI;
- Capacity building in animal health in terms of disease identification, prevention and control program of dairy cattle and other animals;
- Crossbreeding using hybrid bull;
- Identification of mastitis causative agents and identify alternative option of control and prevention methods;
- AST pattern evaluation and development of new effective drug;
- Milk productivity stage evaluation by breeds and blood levels;

Forage

- Adaptability evaluation, demonstration and multiplication;
- Adapatation of improved foragess based on the agro ecology of the woreda;
- Crop residue management (how to treat e.g. Urea treatment and others);

Diseases

- Identify the diseases caused by bacteria in different woredas;
- Serotype identification;
- Strain identification by PCR;
- Develop snail control strategies in marshy area and awareness creation of fasciolisides control and prevention strategies;
- Introduce or produce effective anthelmintic drugs;

Poultry

- Environmental modification and use of improved management for day old chick adaptability;
- Selection of high yielding local breeds of chicken (poultry local breed improvement, sustainability);
- Develop high value poultry management practices;
- Poultry disease investigation (infectious, viral and parasitical diseases);

3.4. Natural Resource Production and Management

3.4.1. Status of natural resource per woreda

Antsokiagemiza woreda

- **Soil resources**

In Antsokiagemiza woreda the dominant soil covering 45% is Cambisols followed by 30% Vertisols, 15% Nitosols and 10% other soil type. The farmers use blanket recommendation for all crops and soil types. From fertilizer type used in the area; DAP/NPS are applied at the time of planting whereas Urea is applied with split application. But farmers complain response of tef for the applied phosphorus fertilizer was low. The farmers also indicated that compost preparation as well as manure application requires high labor and cost as a result they are not practicing this organic fertilizer as recommended.

- **Water resource**

In the woreda 13 rivers are used to irrigate about 2046.799 ha of land, about 14 small springs are used both as modern and traditional irrigation canal systems to irrigate around 798.975 ha with the range of 1.75 to 154.7 ha coverage. Similarly, in 10 kebeles there is ground water with the capacity of irrigating around 3253.41 hectare of land. About eight small springs are used as modern irrigation canal system irrigating around 239 ha of land with the range of 10 to 70 ha coverage. Four springs are used as traditional diversion canals covering 102 hecatres of land with the range of 10 to 50 ha coverage. Community pond (four) can also serve as other water source. In this woreda, there are around 1554 hand dug wells of which 67 are considered as modern hand dug wells having a depth of 1.5 to 11.5 meter, and about 40 geo membranes are available but only 60% is functional.

Generally flooding is a major practice but farmers also practice furrow, drip, basin in small coverage and ring application for perennial trees. In the woreda the diversion intakes structures are worn out. Lack of water lifting mechanism from the depth of 20-30 meter, and ground water excavation spacing were not determined.

- **Land resource**

From the total area of the woreda, the share of agricultural land, cultivated land, land, area closure and wet land shares 14697, 2005, 1068 and 1000 ha^{-1} respectively.

- **Forest resources**

The total forest area of the woreda is 15120 ha^{-1} and of which, bush land and natural forest shares 7314 and 5179 ha, respectively. The major tree species in the natural forest include *Croton macrostachyus (bisana)*, *Podocarpus falcatus* (*zigba)*, *Cordia Africana* (*wanza*), *Grevillea robusta* and *Acacia saligna*. From the total plantation area (2702 ha-1) eucalyptus, *Grevillea robusta, acacia etbaica*, *Acacia nilotica* /Schweinf (kesele) are the most dominant species. Multipurpose tree species found in the woreda are Cordia africana (*wanza*), *Grevillea robusta*, acacia and sesbania.

Efratanagidim Woreda

- **Soil resource**

The dominant soil type covering 39% is nitosols, followed by 38% vertisols, 18% grey, 5% cambisols. Based on their texture, the dominant soil is clay loam. DAP/NPS are used basal application at planting and Urea used as split application.

- **Water resource**

In the woreda there are 26 rivers mainly used for irrigation of 2712 ha of land. Moreover, 60 small springs are used for irrigation supported by modern and traditional irrigation canal systems. Those springs are estimated to irrigate about 2658 ha of land. Out of the total 60 springs 4 small springs are supported by modern irrigation canal system and estimated to irrigate around 518 ha. The remaining 56 springs are supported by traditional diversion ways and cover 2140 ha of land. Other water resources include community ponds (seven), hand dung wells (445) and geo membranes (76) are available for livestock and domestic use. Generally, flooding is a major watering practice followed by furrow and drip irrigation. In addition, ring application is also practiced for perennial trees.

- **Land resource**

In the woreda the total cultivated land is estimated to be 17351 ha of which , grazing land, area closure, wet land and forest land shares 7763, 26099 and 87 8708 ha, respectively.

- **Forest land**

The major natural tree species found in the woreda include *Croton macrostachyus* (*bisana*), *Podocarpus falcatus* (*zigba*), *Cordia Africana* (*wanza*), *Grevillea robusta* , *Acacia saligna* and *Rhamnus prinoides* (*gesho*) while the major plantation tree species are eucalyptus and *Acacia nilotica* (*kesele*).

Kewet Woreda

- **Soil resource**

In Kewet woreda the major soil type covering 55% is Vertisols followed by 22% Cambisols, 15% Nitosols and Gray 8%. Texturally, the dominant soil type is clay loam.

- **Water resource**

Rivers, small to large springs, community water pond, individual ponds, are the major water resources for the woreda. 1571 ha of land is irrigated with eight rivers and about sixty small to large springs are available irrigating around 188 ha of land. Little ground water potential is used for irrigation. Other water resources like community pond and individual ponds are available for livestock and domestic use, and little practice on geo membrane for homestead farming. Generally, flooding is a major practice but they practice furrow and basin in small coverage and for perennial trees ring application was used.

- **Land resource**

In the woreda the cultivated land is estimated to be 20424 ha and of which 9445 ha is grazing land, 274.5 ha is area closure, 4776.5 ha is wet land and forest land 10703 ha is bush, 379.1 ha is natural forest and 1212.75 ha is plantation forest..

- **Forest resource**

Major tree species are *Croton macrostachyus* ("Bisana"), *Podocarpus falcatus* ("Zigba"), *Cordia africana* ("Wanza"), *Grevillea robusta, Acacia saligna, Rhamnus prinoides* ("Gesho"). And the major plantation trees include Eucalyptus, *Acacia nilotica* ("Kesele") and *Acacia polyacantha.*

Tarimaber Woreda

- **Soil resource**

The major soil type covering 38% is Cambisols followed by 22% Gray, 25% others and 3% Vertisols. Texturally, the dominant soil is clay loam.

In the woreda, manure, compost and shredded leaves are used for soil fertility improvement, and also bio fertilizer on the faba bean crops. Fallowing of land is a common practice in nine kebeles.

- **Water resource**

In Tarmaber woreda one river is mainly used for 71 ha of irrigated land, about 8 small springs are used in modern irrigation canal system, around 239 ha irrigated with the range of10 to 70 ha of land coverage and around four springs are used in traditional diversion ways covering 102 ha with the range of 10 to 50 ha of land coverage. Other water sources like 15 community pond, around 288 small pond, and about 94 geo membranes are available in the woreda.

Generally, flooding is a major practice but they also practice furrow, basin in small coverage and ring application of water for perennial trees.

- **Land resource**

From the total area of the woreda the share of cultivated land, grazing land, area closure, wet land are estimated to be 17818, 12814, 6252, and 25 ha, respectively (gizaw desta et.al.). Moreover, forest land is estimated to be about 4003.275 ha of which 193.56 ha is covered with natural forest while the remaining 3071.7 ha is covered with eucalyptus and junipers plantation.

- **Forest resource**

Major tree species are; *Croton macrostachyus* ("Bisana"), *Podocarpus falcatus* ("Zigba"), *Cordia Africana* ("Wanza"), *Grevillea robusta, Acacia saligna,* Rhamnus *prinoides* ("Gesho"). 3071.7 ha of land is covered with eucalyptus and junipers plantation. Major multipurpose tree species found in the woreda are *Croton macrostachyus* ("Bisana"), *Podocarpus falcatus* ("Zigba"), *Cordia africana* ("Wanza"), *Grevillea robusta, Acacia saligna* and *Rhamnus prinoides* ("Gesho").

Bassonawerana Woreda

- **Soil resources**

The major soil type covering 40% is Cambisols followed by 39% Nitosols, 21% Vertisols and clay loam is the dominant textural class found in this woreda. Generally, the soil is highly degraded and has low soil depth due to soil erosion. Depending on the crop type; 2-3 times tillage frequency was practiceed for cereal and vegetable crops more frequently than pulse crops. Fallowing is a common practice in the high land areas. Soil samples were tested for acidity problem in eleven kebeles of the woreda and identified as acidic soils. Among them, some soils were treated with lime but fertilizer rate recommendations based on soil type were not known. Besides, high labor cost for compost preparation and manure application has been identified as a challenge.

- **water resources**

In the woreda six rivers are mainly used as modern irrigation system and have the potential of irrigating 870.5 ha of land. 36 to 318 hectares of land are irrigated with 10 small springs that are used as modern irrigation canal system. Around 502.5 ha of land is irrigated using traditional irrigation system ranging from 5 to 217 ha coverage. And 4 springs are used as traditional diversion ways covering 102 ha with the range of 10 to 50 ha coverage, (BoA at woreda level). Even if the woreda is endowed with high ground water potential, there is low to nil ground water used for irrigation. Other water resources found in the woreda are 11 community ponds, 171 geomembranes and small ponds constructed for livestock and domestic use. There is also little practice with geo membrane in the area.

Generally, flooding is a major practice but farmers also practice furrow, drip, basin in small coverage and ring application for perennial trees. In six kebeles broad bed furrow has been practiced.

- **Land resources**

Basonaworana is located in the Amhara National Regional State and typically known to be frost prone area and highly degraded. The majority of the land escapes are undulating and mountainous and the major soil types are Cambisols and Nitosols. The main water sources for irrigation are rivers and springs. The total cultivated land in the woreda is 63185 ha, grazing land is 12814 ha, area closure is 6252 ha, the wet land is 180 ha (Gizaw *et.al.*, 2010), forest land is estimated to be about 3723.935 ha,out of this 295.03 ha of land is covered with natural forest. Four kebeles are prone to moisture stress and in these kebeles around 5823 trenches have been constructed. The topography, soil type, land slide /earthquake, vegetation cover and rainfall intensity and frequency are the most important aggravating factors for soil erosion.

- **Forest resources**

Major tree species include *Croton macrostachyus* ("Bisana"), *Podocarpus falcatus* ("Zigba"), *Cordia africana* ("Wanza"), *Grevillea robusta, Acacia saligna, Rhamnus prinoides* ("Gesho"). 4584.25 hectares of land are covered with eucalyptus and junipers plantation. Major multipurpose tree species found in the woreda are *Croton macrostachyus* ("Bisana"), *Podocarpus falcatus* ("Zigba"), *Grevillea*

robusta, *Acacia saligna*, *Rhamnus prinoides* (*gesho*) and *Chamaecytisus palmensis* (Tree lucern). Well practice on multipurpose trees based on farmers interest with some resistance on *Acacia saligna*.

Siyadebirnawayu

- **Soil resource**

In the woreda the major soil types covering 90% is Vertisols followed by 6% Cambisols, 1% others and 1% Nitosols. The dominant textural class is clay loam. DAP/NPS are used as basal application at planting and Urea is used in split application.

- **Water resource**

In the woreda one river is mainly used with irrigation potential of 374 ha; there is no ground water potential used for irrigation. Other water resources include 48 community ponds, 288 small ponds, 18 geomembranes and around 12 springs used as traditional irrigation schemes. Generally, flooding is a major practice but they also apply furrow, dripand basin in small coverage and ring application for perennial trees.

- **Land resource**

In the woreda the cultivated land is estimated to be 17351 ha, 9514 ha is grazing land, 524 ha is area closure, 34335.48 ha is forest land, 32274.6 ha is natural forest and.while 18154.4 ha is plantation area.

- **Forest resource**

The major natural tree species are *Acacia abyssinicus* ("Yhabesha girar"), *Croton macrostachyus*/"Bisana", "Wacho", "Tedecha", "Derie" and "Gerba". While the major plantation tree species are eucalyptus, multipurpose tree species yellow wood (*Podocarpus falcatus*) *and Acacia saligna*.

Minjarshenkora

- **Soil resource**

In the woreda the major soil type is cambisols 45.5%, vertisols (black soil) 19%, gray 19.5 %, and nitosols15% and texturally the dominant soil is clay loam.

- **Water resource**

In the woreda 509.631 ha of land is irrigated with nine rivers (by surface water). There is no ground water potential used for irrigation purpose. Other water resources like community ponds 15, small ponds 288, geo membranes 6539 and new 1012, and 50 hand dug wells and 8 concrete ponds are available in addition. Generally, flooding is a major practice but farmers used furrow, drip, basin in small coverage and ring application for perennial trees..

- **Land resource**

From the total area of the woreda; the share of cultivated land, grazing land, area closure, wet land and forest land are estimated to be 17351, 7763, 6225, 87 and 34335.48 ha, respectively.

➢ **Forest resource**

The natural forest /major tree species in the woreda are *Acacia abyssinicus* "Yhabesha girar", *Croton macrostachyus* ("Bisana"), "Wacho", "Tedecha", "Derie" and "Gerba". The major plantation tree is eucalyptus, and the multipurpose tree species Acacia *abyssinicus* ("Yhabesha girar"), *Croton macrostachyus* ("Bisana"), "Wacho", "Tedecha", "Derie", and"Gerba".

Moretinajiru Woreda

- **Soil resource**

In the woreda the major soil types covering 55% is Vertisols (black soil) followed by 40% Gray and 5% Nitosols. Drainage of the excess water with traditional practice called zekosh (closely related with broad bed and furrow) is well practiced on Vertisols.

- **Water resource**

In the woreda 374 ha of land is irrigated with one river. Around 215 springs are used as traditional irrigation schemes. Limited practice on ground water for irrigation. Other water resources also include community ponds (48), small ponds (288), geomembranes (18) are available in the woreda. Generally, flooding is a major practice but farmers also practice furrow, basin in small coverage and ring application especially for perennial trees in the lowlands.

- **Land resource**

In the woreda the highest estimated land use cover is 17351 ha of cultivated land, 9514 ha of grazing land, 524 ha area closure, 34335.48 ha is a forest land and 32274.6 ha is a natural forest.

- **Forest resource**

The major natural tree species are *Acacia abyssinicus* ("Yhabesha girar"), *"Croton macrostachyus" ("bisana")*, "Wacho", "Tedecha", "Derie" and "Gerba". While around 18154.4 ha of land is covered with plantation of eucalyptus tree, *Podocarpus falcatus* ("Yellow wood" / "Zegiba"), *Acacia saligna* are the major multipurpose tree species that are found in the woreda.

3.4.2. Constraints on natural resource production and management

The study areas have the main constraints of

➢ **Soil productivity problems**

- The response of P fertilizer on lowland tef production were not identifieded;
- High labor cost for compost and manure prepation and application;
- Improper compost preparation practice;
- High cost of inorganic fertilizer;
- Absence of soil test based fertilizer rate recommendation;
- Shortage of green manure materials;
- Cow dung is mainly used for energy consumption rather than as fertilizer;
- Lack of bio-fertilizer supply and awareness;
- Severe acidity problems in the highland areas;

- Low practice of lime application;
- Salinity problems in lowland areas;

➢ **Soil Conservation**

- Undulated topography of the area, land slide /earth quicke, low vegetation cover (deforestation), high intensity and frequency of rainfall caused high soil erosion;
- Lack of proper design for soil and water conservation physical structures;
- Low sustainability of soil and water management physical structures;
- Free grazing of animals on area closure is a major problem;
- Ineffective in-situ moisture conservation practices;
- Low survival rate for seedlings of trees and grasses;
- Less following up of seedlings after planting;

➢ **Irrigation Water Management**

- Lack of crop water requirement technologies;
- Poor irrigation scheme management;
- No fixed scheduling of watering;
- No information about the capacity of water in gully rehabilitation structures;
- Lack of improved technologies to produce crops in water logged areas during rainy season;
- Improper use of geo-membrane due to seepage lose, high cost and lack of awareness;
- Evaporation loss and high seepage from irrigation cannals;
- High siltation on water harvesting structures;
- Lack of improved irrigation system,
- Excess use of irrigation water;
- Ground water excavation spacings were not determined;

➢ **Forest Management**

- Low survival rate of seedlings;
- Serious disease and insect problems on eucalyptus trees;
- Lantana camera (Yeowef kolo) is invasive weed on forest, grazing and farm lands;
- Limited types of multi purpose trees species;
- Lack of agroforestry and timber tree species;

3.4.3. Prioritizing problems, screening options and interventions on Natural resource production and management

The main prioritized problems, screening options and the possible intervention options are mainly categorized as soil fertility related problems; agricultural water management and utilization problems; and natural resource production, conservation and management problems. Each category has its own prioritized problems, screening options and possible interventions (Table 13, 14 and 15).

Table 13. Soil fertility problems and screening options

No.	Prioritizing problems,	Screening options	Interventions	Interventions areas
1	Absence of soil test based fertilizer rate recommendation	Technologies	Survey, Evaluation Adaptation/identification	All
2	High cost of inorganic fertilizer	Increase production technologies	Policy making Demonstration of organic fertilizer	all
3	Lack of easy and efficient method of compost preparation	Awareness creation Technologies on earth worm	Training evaluation demonstration	all
4	Cow dung mainly used for energy consumption rather than fertilizer source.	Awareness creation on technologies	Training, demonstration	all
5	Lack of bio-fertilizer supply and awareness	Facility	Training, demonstration	all
6	Soil acidity problem	Technologies	Survey evaluation	High land areas
7	Lack of access to nearby Soil pH analyses laboratory.	Create facility	Capacity buildings on laboratories and human power	On the research centers
8	Low level of practices on lime application	Technologies	Evaluation, demonstration	High land areas
9	Soil Salinity problem on lowland areas	technologies	Survey Evaluation	Low land areas
11	Low access to get metreology information	Create facility	Capacity building on meteorology stations	all
12	Fallowing in the high land area due to soil fertility degradation	Use improved fallow	Demonstration	All high lands

Table 14. Agricultural water management and agro meteorology

S.N.	Prioritized problems,	Screening options	Interventions	Interventions areas
1	Low level of efficient irrigation water utilization high wastage of water	Technologies	Evaluation demonstration	All
2	Lack of water measuring device	Create facility, technologies	Evaluation demonstration	All
3	Didn't considered irrigation regime	Technologies	Evaluation demonstration	All
4	Poor irrigation scheme management	Technologies	Evaluation demonstration	All
5	Poor irrigation system practice	Technologies	Evaluation demonstration	All
6		Technologies on enterprise choice	Evaluation demonstration	All
7	Availability of low quality geomembrane plastic sheet	Facilities awareness	Capacity building demonstration Decision making	All
8	High Seepage and evaporation loss of irrigation water	Technologies that minimize loss	Evaluation demonstration	All
9	Unidentified pond size for appropriate water harvesting	Technologies	Survey	All
10	High Siltation on water harvesting structures	Technologies	Training demonstration	All
11	Little practice on drainage of excess water	Awareness	Training	All
12	Poor sense of ownership on irrigation infrastructures	Awareness	Training	All

Table 15. Watershed based natural resource production and management

S.N.	Prioritized problems,	Screening options	Interventions	Interventions areas
1	Low soil depth due to high soil erosion	Model watershed, technologies on soil erosion	Evaluation Develop watershed management	High land
2	Lack of gully rehabilitation technologies	Gully rehabilitation technologies	Evaluation, demonstration	All
3	Lack of proper design for physical structure (bench terrace, micro basin, eye brow basin, soil bund) especially on mass mobilization work	Technologies, close follow up	Training demonstration	All
4	Lack of technical skill to use technologies like GPS	Technologies, skills	Trainings and capacity building	All
5	Lack of effective watershed management practices,	Working based on water shed	Develop learning watershed	All
	Forestry and agro forestry			
1	Low survival rate of seedlings	Technologies	Adaptation	All
2	Lack of adaptable multipurpose tree species other than eucalyptus tree	Adapted multipurpose tree species	Introduction Adaptation	All
3	Serious problem on eucalyptus trees disease and insect pests	Identifying the diseases and insect type	Survey evaluation	All
4	Low level of following up of vegetations after plantation.	Follow up	Decision making	All
5	Problems related to management of free grazing	Create awareness	Policy making	All
6	Sustainability problems of area closure	Create awareness	Policy making	All

3.4.4. Recommendations and outlines of research and development proposals on natural resource production and management

The research proposals are designed based on the prioritized problems to address the basic problems identified at different level of constraint identification procedures. The research proposals are categorized as soil fertility related research proposals, agricultural water management proposals and natural resource production and management proposals.

3.4.4.1. Soil fertility and problematic soils research proposal

- Evaluation of soil test based fertilizer rate recommendation for major crops;
- Evaluate and demonstrate easy and efficient method of compost preparation using earth worm;
- Evaluation and demonstration of comparative advantage of cow dung for organic fertilizer;
- Demonstration of bio-fertilizer for food legumes;
- Identification of soil acidity and demonstration of technologies to reduce soil acidity in the high land areas;
- Determine and demonstrate lime rate and application;
- Identify and demonstrate on saline soil problems and possible intervention on the low land areas;
- Develop and evaluate vertisols management options;
- Demonstrate improved fallowing practice in the high land areas to improve soil fertility;

3.4.4.2. Agricultural water management and agro meteorology research proposals

- Develop efficient irrigation methods to maximize water use efficiency;
- Develop easy and locally available water measuring devices;
- Determination of irrigation water regime for major crops;
- Develop irrigation scheme management;
- Develop and evaluate suitable drainage practices;
- Develop plot based cropping sequences on irrigation schemes for different agro-ecologies;
- Develop appropriate design on ex-situ rain water harvesting structures;
- Identifying the technical evaluation of rain water harvesting structures;

3.4.5. Natural resource production and management proposals

❖ Watershed based soil and water conservation research proposals

- Identify and estimate annual soil loss by runoff;
- Develop and demonstrate gully rehabilitation technologies;
- Demonstrate and follow up proper design for physical soil and water conservation structure;
- Build the capacity of experts and DAs on technology usage like how to use GPS devices;

❖ Forestry and agro forestry research proposals

- Introduce and develop easy technologies to maximize survival rate of seedlings;

- Adaptation and introduction of multipurpose tree species for different agro ecologies;
- Identification of management options for eucalyptus trees disease and insect pests;
- Prepare guidelines for schools and create awareness on how to follow up trees after planting;
- Experience sharing and awareness creation on proper area closure practices;

Table 16. Prioritized problems, recommendations from research, recommendation domains and responsibility matrix

No	Prioritized problem	Required technologies	Possible intervention	Responsibility
1	Absence of soil test based fertilizer rate recommendation	Soil test based P fertilizer recommendation	Demonstration	Resarche
2	High cost of inorganic fertilizer	Alternatives like Green manure. Farm yard manure and compost	Evaluation	Research and university
3	Lack of easy and efficient method of compost preparation	Vermicomposting:	Demonstration	Research and extension
5	Low level supply and awareness on bio-fertilizer inoculants		-Awareness creation – -Demonstration	Extension, Research and university
6	Soil acidity problem	Soil acidity management with lime and FYM:	Demonstration on Barley growing areas	Research and University
7	Lack of access to nearby Soil pH level analyses laboratory.			AGP Research center SWM research directorate
8	Low level of practices on lime application			AGP SWM research directorate (soil fertility)
9	Soil Salinity problem on lowland areas	Role of Mulching Materials on Salinity Reduction:	Low land areas with salinity problems	SWM research directorate (soil fertility) AGP Socieconomics

No	Prioritized problem	Required technologies	Possible intervention	Responsibility
				research directorate
10	Low access to get agro-meteorology and information			Research center (DBARC) SWM research directorte
11	Soil fertility degradation leads to fallowing on high land areas	Improved fallow:	Demonstration	Research and university
12	Low level of efficient irrigation water utilization high wastage of water	Technologies	Demonstration and awareness creation	Extension and research
13	Lack of water measuring device	Inputs	Market linkage	Extension
14	Poor consideration of irrigation rules and regulations		Awareness	Research and extension
15	Poor irrigation scheme management		Awareness	Extension
16	Poor irrigation system practice		Demonstration	Research and extension
17	Lack of cropping sequence technologies	Technology	Evaluation	Research
18	Low quality of geomembrane plastic sheet		Assesement	Research and extension
19	High Seepage and evaporation loss of irrigation water		Awareness	Extension
20	Poor sense of ownership on irrigation infrastructures		Awareness	Extension

4. REFERENCES

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5. APPENDEXES

Appendix 1 Characteristics of the study area

Parameters	Antsokia gemza	Efratanagidim	Kewet	Tarmaber	Bassonawerana	siyadebirnawayu	Moretinajiru	Minjar shenkora
Number of kebeles	U**=2	3	2	4	1	1	2	2
	R**=15	19	16	19	30	13	18	27
Distance from zone	208	140	95	60	-	65	47	260
Distance from Addis	347	269	225	190	130	155	177	130
Population	M*=48042	54418	??	53079	71373	38653	52387	80573
	F*=45475	51465	??	49853	63464	31943	55381	75575
Total								
House hold head	M*=10203	15513	9992	11343	18859	9435	14932	20186
	F*=4567	6814	8778	2391	10080	1847	2253	1544
Total								
Temperature in 0^{c}	Ave=20	21.6	25	20	12	17.5	17	21
	Min=-	18	13.3	15	-2	15	16	-
	Max=-	32	29	25	20	20	18	-
Annual Rain fall in MM	Ave=800	1018	750	1250	960	1247	950	
	Min=700	450	600	1100	950	995	900	
	Max= 900	1296	900	1400	1200	1500	100	
Rain fall Distribution	Regular	Erratic	Erratic	Regular	Even and regular	Regular	Regular	Erratic
Rain fall Duration	End of June –	July to September first	First week	June to mid-	June to first week of	June to September	July to September	Mid-June-September

Parameters	Antsokia gemza	Efratanagidim	Kewet	Tarmaber	Bassonawerana	siyadebirnawayu	Moretinajiru	Minjar shenkora
	Mid August	week	of July to August end	September	September			first week
Altitude range	1400-3600	1250-3600	1500-2500	1450-3186	1300-3400	2000-2650	1400-2680	1040-2380
Agro ecology in %	H***=11	22.8	27	54.25	52	88.9	40	4.3
	M***=44	60.8	29	28.5	46	9.2	35	70.9
	L***=45	16.4	44	17.25	2	1.9	25	24.8
Land scape in %	F***=43	25	26	3.5	70	75	30	84
	Un***=8.3	-	21	36.5	10	13	10	14
	M***=46.7	48	36	45	4	2	35	2
	H***=2	27	17	15	16	10	25	
Land use system in ha	Arable=14690	16210	-		42828	21789		48803.3
	Non-arable=-	7967	-		3063	3000		
	Grazing=2005	7763	9445		18256	3270		464
	Vegetation=15720	17%	-		3814	-		
	Forest=15720	8708	8673		18290	652		34335.5
	Bush=	12411	10703		-	-		-
	Wet=250	87	-		9.22	-		-

Parameters	Antsokia gemza	Efratanagidim	Kewet	Tarmaber	Bassonawerana	siyadebirnawayu	Moretinajiru	Minjar shenkora
	Others =-				-	17387		-
Major soil types in %	Brown 45% Black 30% Red 15% Others 10%	Brown 5% Black 38% Red 39% Gray 18%	Brown 22% Black 55% Gray 8% Red 15%	Brown 38% Black 3% Gray 22% Others 25%	Brown 40% Black 21% Red 39%	Brown 6% Black 90% Red 1% Others 3%	Black 55% Red 5% Gray 40%	Brown 45.5% Black 19% Gray 19.5%Red 15%
Average farm size in ha	1	0.75	1	1 ha	1.5 ha	1.5 ha	0.75 ha	1.25
Average family size	4.5	5	5	5	5	5	4	5.5
Dependency ratio	1.16	1.17	1.2	1.73	1.14	1.1	1.21	1.7

** M= male, F= female, **U= Urban, **R = Rural., U***= undulated land, ***M= mountaineous land, ***L= low land etc...*

Appendix 2. Type and sources of improved variety of seed

Crop type	Woreda							
	Ansokiagemza		Kewet		Efratana Gidim		Tarmaber	
	Name of improved varieties	Source of improved varieties	Name of improved varieties	Source of improved varieties	Name of improved varieties	Source of improved varieties	Name of improved varieties	Source of improved varieties
Bread wheat			Kekeba	Union	Danda	MOA	Digalo, Tsehay and Huluka	Union and DBARC
Tef	Boset, Quncho and Cross-37	MOA			Quncho	MOA	Quncho	Union
Sorghum	Brihan, Gobiye, Hormat and Girama-1	SARC and MOA	Girana 1, Gobiye, Abshir, Birhan and Chare	MOA and DBARC	Girana 1, Chare	AGP and DBARC	Girana -1	SLM and AGP
Food barley							HB – 1307, Agnehu, Baso	SLM, AGP and DBARC
Maize			Katumani, Awash 511	MOA	BH-540	MOA		
Faba bean							Walki andDosha	DBARC
Chickpea	Ararti	MOA						
Potato	Belete, Gudene, jalene,	Bureau of Agriculture	Gera, Gorebela	SLM	Gera, Shenkola	MOA	Gera	DBARC and SLM
Tomato	Roma BF	market			unknown variety	market		

Crop type	Woreda							
	Ansokiagemza		Kewet		Efratana Gidim		Tarmaber	
	Name of improved varieties	Source of improved varieties	Name of improved varieties	Source of improved varieties	Name of improved varieties	Source of improved varieties	Name of improved varieties	Source of improved varieties
Onion	Bombe red and Adama red	market	Adama red and Bombe red	market	Adama red and Bombe red	market		
Mango	Kent, Tomi and Apple	World vision and Woreda Bureau of Agriculture	Apple, Kent and Kit	MOA	Apple, Kent, tomi and Kit	MOA		
Banana	Dwarf and Giant Cavendish	Woreda Bureau of Agriculture	Jint Cavendish and Dwarf cavendish	MOA/AGP	Jint Cavendish, and Dwarf Cavendish	MOA		

Crop type	Woreda							
	Siyadebrinawayu		Bassona Worana		Minjar Shenkora		Moretina Jiru	
	Name of improved varieties	Source of improved varieties	Name of improved varieties	Source of improved varieties	Name of improved varieties	Source of improved varieties	Name of improved varieties	Source of improved varieties
Bread wheat	Dandea, Hidase, Menze, Bolo, ET-13, Dashen	Amhara seed enterprise and DBARC	Digalo, Bolo, Menze, Tsehay	DBARC	Kekeba, Danda, Hidase, Ogalcho, Shorima, Hr-1685, Qubsa, Pavel-75, Kingberd	Farmers, Kulumsa ARC and EAAP	Danda, Digalo, ET-13, Menze, Bolo, Tsehay	EAAP, DZARC, DBARC
Tef	Dega tef	Amhara seed enterprise and DBARC	-	-	Boset, Quncho, Cora and Cross-37	DZARC	Quncho, Dega tef, Kora Boset	DBARC, DZARC
Sorghum							Girana -1	Union
Food barley			HB 1307, Holeta	DBARC				
Faba bean			Wolki and Degaga	DBARC	Degaga, Dosha, Wolki, Mesay Moti, Tumsa	DZARC	Dagem, Walki	Amhara seed enterprise
Chickpea	Ararti Natoli Habru	DBARC	Ararti Natoli Habru	DBARC	Ararti, Shasho, Natoli Ejersa, Akos, Habru	DZARC	Ararti Natoli Habru	Amhara seed enterprise
Potato			Gera,	DBARC				

Crop type	Woreda							
	Siyadebrinawayu		Bassona Worana		Minjar Shenkora		Moretina Jiru	
	Name of improved varieties	Source of improved varieties	Name of improved varieties	Source of improved varieties	Name of improved varieties	Source of improved varieties	Name of improved varieties	Source of improved varieties
			Gorebela Shenkola					
Tomato					Unknown variety	market		
Onion	Adama red	market	Bombe red	market	Adama red and Bombe red	market		
Mango	Apple	Orthodox			Apple	MOA		
Banana	Unknown variety	Orthodox						

Appendix 3. Major pests of crop production by crop type in AGP woredas

Woreda	Major Pests	Crop Type							
		Tef	Wheat	Maize	Barley	Sorghum	Faba bean	Chickpea	Sesame
Siyadebema wayu	Weed:	*Anagallis aruense, Phalaris Paradoxa L.*	*Anagallis aruense,*	-	*Avena fataua L. Phalaris paradoxa L. Anagallis aruense*	*Striga hermonthica*	*Anagallis aruense Phalaris paradoxa L.*	*Phalaris paradoxa L.*	-
	Insect:	Shoot fly	-	-	-	Stoke borer	African Ball worm	African ball worm	-
	Disease :	-	Yellow rust	-	-	Smut	Chekolet spot Faba bean gall Root rot	Root rot Wilt	-
Moretnajiru	Weed:	*Anagallis aruense Phalaris paradoxa L.*	*Anagallis aruense*	-	*Avena Fatua L., Phalaris paradoxa, L. Anagallis aruense*	*Striga hermontica*	*Anagallis aruense Phalaris paradoxa L.*	*Phalaris paradoxa L.*	
	Insect:	Shoot fly	-	-	-	Stoke borer	African Ball worm	African ball worm	
	Disease :	-	Yellow rust	-	-	Smut	Chekolet spot Faba bean gall Root rot	Root rot Wilt	
Basona worana	Weed:	*Phalaris paradoxa L.*	*Phalaris paradoxa*	-	*Guizotia Scabra*	*Striga hermontica*	*Anagallis aruense*	*Anagallis aruense*	

Woreda	Major Pests	Crop Type							
		Tef	Wheat	Maize	Barley	Sorghum	Faba bean	Chickpea	Sesame
			L.		*(Vis.) chiov*				
	Insect:	Shoot fly	Aphids	-	-	Stoke borer	African Ball worm	African ball worm	-
	Disease:	-	Yellow rust	-	rust	-	Faba bean gall	gall	-
Minjar shenkora	Weed:	*Phalaris paradoxa L., Cammelina bengalenssis L., Cyperus rotundus L., Erucastrum arabicum, Snowdenia polystachia pilg., Avena fatua L.*	Commelina benghalensis L., *Guizotia Scabra (Vis.) chiov, Erucastrum arabicum, Snowdenia polystachya Pilg., Avena Fatua L.*	*Commelina Benghalensis L., Convolvules arvensis L.*	*Commelina benghalensis L., Guizotia scabra (Vis.) Chiov, Erucastrum arabicum Fisch. Snowdenia polystachya (Fresen.)pilg , Avena fatua L.*	*Stiga hermonthica, Phalaris paradoxa L.., Commelina benghalensis L., Cyperus rotundus L., Erucastrum arabicum, Snowdenia polystachya (Fresen.)pilg., Avena fatua L.*	*Phalaris paradoxa L. Scorpiurus muricatus L Bromus pectinatus Thunb. Avena fatua L.*	*Commelina benghalensis L. Guizotia scabra (Vis.) Chiov Erucastrum arabicum Fisch. andMey Snowdenia polystachya (Fresen.)pilg , Avena fatua L..*	
	Insect:	Shoot fly, Musack, Key yatef til	-	Ball worm, Stock borrer	-	Stoke borer	African Ball worm, Aphid	African ball worm, Aphids	
	Disease:	-	Rust, Septoria	-	-	Smut	Faba bean gall, Chekolet	Root rot, wilt	

Woreda	Major Pests	Crop Type							
		Tef	Wheat	Maize	Barley	Sorghum	Faba bean	Chickpea	Sesame
							spot, Root rot		
Tarmaber	Weed:	*Phalaris paradoxa L.* Echinocloa colona (L.) Link *Cyperus rotundus L. Cynodon nlemfuensis Vanderyst Commelina benghalensis L.*	*Xanthium strumarium L. Argemone mexicana L Echinocloa colona (L.) Link*	*Stiga hermonthica Commelina benghalensis L.*	*Xanthium strumarium L. Argemone mexicana L Echinocloa colona (L.) Link*	*Stiga hermonthica Commelina benghalensis L. Argemone mexicana L*	*Xanthium strumarium L. Phalaris paradoxa L.*	*Xanthium strumarium L. Phalaris paradoxa L.*	
	Insect:	Key yatef til	Aphids Army worm	Ball worm, Army worm, Stock borer, Meage	Army worm, Aphids	Ball worm, Stock borer, Meage	Aphids	Aphids	
	Disease :	-	Yellow rust, Stem rust, leafe rust	-	Smut	Smut	Faba bean gall, Chekolet spot	-	
Kewet	Weed:	*Phalaris paradoxa L.* Echinocloa colona (L.) Link *Cyperus rotundus L. Cynodon nlemfuensis*	*Xanthium strumarium L. Argemone mexicana L Echinocloa colona (L.) Link*	*Stiga hermonthica Commelina benghalensis L.*	*Xanthium strumarium L. Argemone mexicana L Echinocloa colona (L.) Link*	*Stiga hermonthica Commelina benghalensis L. Argemone mexicana L*	*Xanthium strumarium L. Phalaris paradoxa L.*	*Xanthium strumarium L. Phalaris paradoxa L.*	-

Woreda	Major Pests	Crop Type							
		Tef	Wheat	Maize	Barley	Sorghum	Faba bean	Chickpea	Sesame
		Vanderyst Commelina benghalensis L.							
	Insect:	Key yatef til	Aphids Army worm	Ball worm, Army worm, Stock borer, Meage	Army worm, Aphids	Ball worm, Stock borer, Meage	Aphids	Aphids	-
	Disease :	-	Yellow rust, Stem rust, leafe rust	-	Smut	Smut	Faba bean gall, Chekolet spot	-	-
Efratana gidim	Weed:	*Bromus pectinatus Thunb. Cyperus esculentus L. Trifolium rueppellianum Cynodon nlemfuensis Vanderyst*	*Xanthium strumarium L. Xanthium strumarium L. Bromus pectinatus Thunb. Lolium temulentum L.*	*Stiga hermonthica Cyperus rotundus L. Cynodon nlemfuensis Vanderyst Trifolium rueppellianum*	*Xanthium strumarium L. Xanthium strumarium L Cyperus rotundus L. Cynodon nlemfuensis Vanderyst Guizotia scabra (Vis.) Chiov*	*Stiga hermonthica Parthenium hysterophorus L. Cynodon nlemfuensis Vanderyst*	*Orobanche minor smith Xanthium strumarium L. Trifolium rueppellianum Guizotia scabra (Vis.) Chiov*	*Xanthium strumarium L. Cyperus rotundus L. Bromus pectinatus Thunb.*	-
	Insect:	Key yatef til, shoot fly, fenta, Degeza	Shoot fly	Ball worm, Cut worm, Stock borer	Shoot fly	Ball worm, Stock borer,	-	African ball worm	-

Woreda	Major Pests	Crop Type							
		Tef	Wheat	Maize	Barley	Sorghum	Faba bean	Chickpea	Sesame
	Disease :	-	Yellow rust, Stem rust, leafe rust	Smut	Stem rust, leafe rust, Smut	Smut	Faba bean gall, Chekolet spot, root rot	rust	-
Antsokia gemza	Weed:	*Phalaris paradoxa L. Cyperus rotundus L.*	*Phalaris paradoxa L. Cyperus rotundus L. Trifolium rueppellianum Polygonum nepalense Meisn.*	*Stiga hermonthica Parthenium hysterophorus L.*	*Guizotia scabra (Vis.) Chiov Trifolium rueppellianum Phararis paradx Avena fatua L. Cynodon nlemfuensis Vanderyst*	*Stiga hermonthica Parthenium hysterophorus L.*	*Guizotia scabra (Vis.) Chiov Trifolium rueppellianum Phalaris paradoxa L.*	*Cyperus rotundus L. Phalaris paradoxa L.*	-
	Insect:	Shoot fly Key yatef til	-	Stke borer and ball worm	Aphids	Stoke borer and ball worm	African Ball worm, Aphids and cut worm	Cut worm	-
	Disease :	-	Yellow rust, leaf rust and stem rust	Smut and anthracnosis	-	Smut and anthracnosis	Chekolet spot Faba bean gall	-	-

Woreda	Major Pests	Crop Type					
		Potato	Tomato	Onion	Mango	Banana	Coffee
Siyadeberna wayu	Weed:	*Snowdenia polystachya*	*Anagallis aruense Phalaris paradoxa L.*	*Snowdenia polystachya Phalaris paradoxa L.*	*Parthenium hysterophorus L.*	*Guizotia scabra (Vis) Chiov Anagallis aruense*	*Cynodon nlemfuensis Vanderyst Parthenium hysterophorus L.*
	Insect:	-	-	-	Skell	-	-
	Disease:	Blight	-	-	-	-	Wilt
Moretnajiru	Weed:	*Snowdenia polystachya*	*Anagallis aruense Phalaris paradoxa L.*	*Snowdenia polystachya Phalaris paradoxa L.*	*Parthenium hysterophorus L.*	*Guizotia scabra (Vis) Chiov Anagallis aruense*	*Cynodon nlemfuensis Vanderyst Parthenium hysterophorus L.*
	Insect:	-	-	-	Skell	-	-
	Disease:	Blight	-	-	-	-	Wilt
Basona worana	Weed:	*Cynodon nlemfuensis Vanderyst, Xanthium strumarium L., Cyprus rotundus L.*	Anagallis aruense *Phalaris paradoxa L.*	*Cynodon nlemfuensis Vanderyst, Guizotia scabra (Vis) Chiov*	*Cynodon nlemfuensis Vanderyst, , Guizotia scabra (Vis) Chiov*	*Snowdenia polystachya (Fresen.) Pilg.,* Ashekt, *Cynodon nlemfuensis Vanderyst.*	*Snowdenia polystachya (Fresen.) Pilg.,* , Ashekt, *Cynodon nlemfuensis Vanderyst.*
	Insect:	Tuber moth, Aphid	Trips	Trips, Aphids	Aphid	-	Antestia bug
	Disease:	Blight, rust	Bloosum end rot, fruit cracking,	Bulb rot, purple blotch	Anthracnose, powdery mildew	Banana wilt	Coffee rust, CBD,

Woreda	Major Pests	Crop Type					
		Potato	Tomato	Onion	Mango	Banana	Coffee
			bacterial wilt, powdery mildew, early blight				
Minjar shenkora	Weed:	-	*Commelina benghalensis L.*, *Cyperus rotundus L.*, Gime, *Phalaris paradoxa L.*, Asefaris	*Snowdenia polystachya (Fresen.) Pilg.*, *Cyperus rotundus L.*, Gime, *Phalaris paradoxa L.*, Asefaris	*Cyperus rotundus L Phalaris paradoxa L.*, *Convolvulus arvensis L.*	-	-
	Insect:	-	Cut worm	-	-	-	-
	Disease:	Blight, root rot	-	Root rot	Powdery mildew	-	-
Tarmaber	Weed:	*Snowdenia polystachya (Fresen.) Pilg.*, *Commelina benghalensis L.*	*Snowdenia polystachya (Fresen.) Pilg.*, *Xanthium strumarium L.*	*Echinocoloa colona (L.) Link*, *Cyperus esculentus L.*	*Cynodon nlemfuensis Vanderyst*, *Cyperus esculentus L.*, *Echinocoloa colona (L.) Link* *Snowdenia*	*Xanthium strumarium L.*, *Cyperus esculentus L.*	*Snowdenia polystachya (Fresen.) Pilg.*, *Cyperus esculentus L.* *Snowdenia polystachya (Fresen.) Pilg.*,

Woreda	Major Pests	Crop Type					
		Potato	Tomato	Onion	Mango	Banana	Coffee
					polystachya (Fresen.) Pilg.,		
	Insect:	Zememit	Ball worm, Aphids	Leaf minor, Trips, Aphid	White scale	-	-
	Disease:	Powdery mildew, Early blight	Powdery mildew, Wilt	Root rot, Purple blotch, powdery mildew	Anthracnose, powdery mildew	-	-
Kewet	Weed:	*Snowdenia polystachya (Fresen.) Pilg., Commelina benghalensis L.*	*Snowdenia polystachya (Fresen.) Pilg., Xanthium strumarium L.*	*Echinocoloa colona (L.) Link, Cyperus esculentus L.*	*Cynodon nlemfuensis Vanderyst, Cyperus esculentus L., Echinocoloa colona (L.) Link Snowdenia polystachya (Fresen.) Pilg.,*	*Xanthium strumarium L., Cyperus esculentus L.*	*Snowdenia polystachya (Fresen.) Pilg., Cyperus esculentus L. Snowdenia polystachya (Fresen.) Pilg.,*
	Insect:	Zememit	Ball worm, Aphids	Leaf minor, Trips, Aphid	White scale	-	-
	Disease:	Powdery mildew, Early blight	Powdery mildew, Wilt	Root rot, Purple blotch, powdery mildew	Anthracnose, powdery mildew	-	-
Efratana gidim	Weed:	*Bromus pectinatus*	*Xanthanium strumarium L.,*	*Striga hermonthica, Cyperus rotundus L..,*	*Xanthanium strumarium*	*Striga hermonthica, Parthenium*	*Orobanche minor smith, Xanthanium strumarium L.,*

Woreda	Major Pests	Crop Type					
		Potato	Tomato	Onion	Mango	Banana	Coffee
		Thunb, Cyperus rotundus L., Trifolium rueppellianum, Cynodon nlemfuensis Vanderyst	*Bromus pectinatus Thunb, Lolium temulentum L.*	*Cynodon nlemfuensis Vanderyst, Trifolium rueppellianum,*	*L., Xanthanium strumarium L., Cyperus rotundus L.,, Cynodon nlemfuensis Vanderyst, Guizotia scabra (vis.) Chiov*	*hysterophorus L., Cynodon nlemfuensis Vanderyst*	*Trifolium rueppellianum, Guizotia scabra (vis.) Chiov*
	Insect:	Key yatef til, shoot fly, fenta, Degeza	Shoot fly	Ball worm, Cut worm, Stock borer	Shoot fly	Ball worm, Stock borer,	-
	Disease:	-	Yellow rust, Stem rust, leafe rust	Smut	Stem rust, leafe rust, Smut	Smut	Faba bean gall, Chekolet spot, root rot
Antsokia gemza	Weed:	*Cyperus rotundus L. Avena fatua L. Cynodon nlemfuensis Vanderyst*	*Cyperus rotundus L. Cyperus rotundus L. Partheniu m hysteropho rus L.*	*Parthenium hysterophorus L., Cyperus rotundus L.,* Congress weed	*Parthenium hysterophorus L. Cyperus rotundus L.* Congress weed	*Cyperus rotundus L.*	Asefaris *Parthenium hysterophorus L. Cyperus rotundus L.*

Woreda	Major Pests	Crop Type					
		Potato	Tomato	Onion	Mango	Banana	Coffee
	Insect:	Tuber mouth	Leaf miner, Aphids, Trips, cut worm	Trips, shoot fly, Aphids	Mediterranean fruit fly and Aphids	-	Antestia bug
	Disease:	-	Early blight, root rot	Purple blotch and root rot	Anthracnose and powdery mildew	-	CBD

Appendix 4. Livestock type and population in the study area

Woreda	Cattle		Poultry		Sheep			Goat			Donkey	Mule	Horse	Camel	Bee Hive		
	Local	Cross	Local	Exotic	Local	Cross	Exotic	Local	Cross	Exotic	------	---	-----	-----	Traditional	Transitional	Modern
Antsokia	26,908	--------	41,086	8,564	27,129	-----	-----	18,306	-------	-----	9,311	373	379	---------	2,829	82	266
Efratana gidim	116,222	1,314	141,247	14,740	66,478	427	4	65,042	28	2	20,088	2,238	2,586	3,100	2,394	16	299
Basona werana	82,321	29,607	167,476	9153	133,901	-------	-------	48,414	------	-----	26,347	187	5350	-------	5639	171	335
Minjar	37,225	------	136,329	9,375	39,157	-------	-------	54,408	-------	------	28,750	1,410	840	4,296	1,443	96	662
Siyadebirna wayo	52,040	7,827	65,800	21,156	90,190	126	------	11,456	------	------	17,248	46	10,856	------	1,723	---------	875
Tarma Ber	59,289	527	62,713	18,512	42,294			46,384			13,574	386	1,003	484	260	7	373
Moretna Jiru	51,922	4,950	59,828	11,149	25,713	278		30,419			17,879	45	3,769		2,137	130	384
Kewet	87,382	60	36, 506	9, 375	54, 400	290	4	128, 564	16	2	10,264	161	86	1660	1179	21	469

Appendix 5. Health management by animal type

Woreda	Dairy				Sheep and goat				Poultry				Apiculture		
	Disease	Parasite	Traditional Mgmt	Modern Mgt	Disease	Parasite	Traditional Mgmt	Modern Mgmt	Disease	Parasite	Traditional Mgmt	Modern Mgt	Disease	Parasite	MGMt
Antsokia	Mastitis, B. leg, pneumonia, pasteurellosis and LSD	Liver fluke, nematodes, menge demodex and tick	Separate diseased animal from the healthy.	Treating by antibiotic, anthelmintic vaccination and separate diseased animals from the healthy.	Pasteurellosis, sheep pox and goat pox	Liver fluke, nematodes, hydatidosis and oestrus ovis, menge, sheep kid, L, worm, orf and demodex	Separate diseased animals from the healthy.	Treating by antibiotic, anthelmintic, vaccination and separate diseased animals.	Fowl pox, fowl-cholera, gumboro, typhoid and newcastle	Coccidiosis, ascaris, tape-worm, menge lice and others.	Separate diseased animals	Vaccination and treating using anti-Coccidiosis.		Wax mouse	
Efratanagidim	Pasteurellosis, black leg and FMD	Fasciolosis, L. worm and strongaie		Treating by antibiotics vaccination and anthelmintic	Pasteurellosis, orf, sheep and goat pox	Liver fluke, nematodes.		Treating by antibiotic vaccination and *anthelmintic*	NCD	Coccidiosis		Vaccination and treating by anti-Coccidiosis			
Basonawerana	Black leg, Anthrax, FMD and LSD	Liver fluke, nematodes	There are some traditional usage of treatment yet not identified	Treating by antibiotics vaccination and anthelmintic	Pasteurellosis, foot rot, sheep and goat pox	L. worm liver fluke and GIT parasite	There are some traditional usage of treatment yet not identified	Treating by antibiotic vaccination and anthelmintic	NCD, Fowl pox, fowl-typhoid, and gumboro,	Vaccination and treating using antibiotic					
Minjar	Mastitis, LSD, pasteurellosis, FMD, anthrax and	Nematodes and ascaris.		Treating by antibiotic vaccination and anthelmintic.	Pasteurellosis ,sheep pox, goat pox,	Nematodes and ascaris.		Treating by antibiotic vaccination and	Neucastle and typhoid	coccidiosis		Vaccination and treating by anti-coccidio			

Woreda	Dairy				Sheep and goat				Poultry				Apiculture		
	Disease	Parasite	Traditional Mgmt	Modern Mgt	Disease	Parasite	Traditional Mgmt	Modern Mgmt	Disease	Parasite	Traditional Mgmt	Modern Mgt	Disease	Parasite	MGMt
	CBPP				CCPP, PPR			anthelmintic				sis.			
Siyadebirna Wayo	Black leg, Anthrax, FMD and mastitis	Fasciolosis, L. worm	not identified herbal medicine	Treating by antibiotic vaccination and anthelmintic.	Pasteurellosis ,sheep pox, goat pox, Anthrax	L. worm liver fluke		Treating by antibiotic vaccination and anthelmintic.	NCD, Fowl pox	Coccidiosis		Vaccination and treating by anti-Coccidiosis			
Tarma Ber	Black leg, Anthrax and pasteurellosis,	Fasciolosis, Nematodes and ascaris.		Treating by antibiotic vaccination and anthelmintic.	Pasteurellosis ,sheep pox, goat pox,	L. worm liver fluke		Treating by antibiotic vaccination and anthelmintic.	NCD	Coccidiosis		Vaccination and treating by anti-Coccidiosis			
Moretna Jiru	Mastitis, LSD, pasteurellosis, FMD, anthrax and CBPP	Liver fluke, nematodes, menge , demodex and tick		Treating by antibiotic and anthelmintic.	Pasteurellosis ,sheep and goat pox, and CCPP	nematodes and liver fluke		Treating by antibiotic vaccination and anthelmintic.	NCD	Coccidiosis		Vaccination and treating by anti-Coccidiosis			
Kewet	Mastitis, B. leg pasteurellosis, anthrax and CBPP	Ticks	not identified herbal medicine	Treating by antibiotic and anthelmintic.	Pasteurellosis ,sheep and goat pox, anthrax and CCPP	Lice, menge and ticks		Treating by antibiotic , vaccination and acaricida		Coccidiosis		Vaccination and treating by anti-Coccidiosis			

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