Sub-theme 1: Animal Production and Health

Animal production and Health Sub-thematic Research have six research areas. These research areas are dealing on animals, on the environment where the animals are living, on animal products and interest of people on animals and animal products. All interested team members were invited to participate in the selection of research priority areas. Hot discussions were made and the priority research area was directed towards selecting individual research commodity. Considering the national research priority and Eastern Ethiopian condition in relation to Haramaya University research mandate area, four livestock research commodities have got priority and selected unanimously. These research commodities are selected to improve productivity in Eastern Ethiopia. The selected research focus areasbased on their order of priority are briefly presented as follows:

1.1. Forage Production and Rangeland Management in Eastern Ethiopia

Though animal production is common and economically a lucrative business in Eastern Ethiopia, there is huge gap and scarcity in feed availability. Rangelands in Eastern Ethiopia are not well defined. Hence, this research focuseson:

- Develop forage production system, agronomic practice and different forage species
- Improving feed resource and water availability of rangelands
- Adopting and up-scaling feed treatment technologies
- Assessment of rangeland resource

1.2. **Chicken Productivity Improvement in Eastern Ethiopia**

Smallholder chicken is an integral component of the livelihoods of nearly all poor rural households. However, germplasm resources are generally under-exploited and under-leveraged due to management problems, lack of effective capacity for testing, multiplication, and delivery to farmers, followed by continuous genetic improvement. Poultry diseases such as Newcastle disease, infectious bursal disease and infectious coryza are the most important hindrance to improved poultry industry. This research focus areas include

- Selection of potential chicken ecotype and on station genetic performance and feed conversion evaluation under optimum management
- Adoption and demonstration of tropical dual-purpose chicken breeds
- Feeding different herbs to improve productivity of dual purpose chicken
- Optimizing poultry feeds with different non-conventional feeds
- Development of synthetic breeds
- Epidemiological study of ND, IBD and IFC and design control methods
- Preparation and use of a local vaccine using local NDV, IBDV and IFC strains
- Determination of a vaccination regime for indigenous village chicken and commercial small holders by vaccinating using imported and local vaccine strains
- On-farm vaccination of indigenous village chickens and commercial chickens with ND, GD and IFC vaccine in selected smallholder farms

1.3. **Sheep and Goat productivity improvement in Eastern Ethiopia**

There is limited selection and genetic improvement, and lower productivity of local sheep and goats; poor husbandry and high mortality rate of lambs and kids; lack of technologies to improve feeds and feeding methods; presence of serious infectious diseases (CCPP, PPR etc) are hampering export of small ruminants and meat from these species to prime meat markets with better economic return; lamb and kid morbidity and mortality are widespread in goat rearing areas of the country affecting growth and replacements;reproductive disorders resulting in abortion are common in local

sheep and goats and parasitic diseases are among the most important causes of productivity loss in adult sheep and goats. Hence, the research focus of this research area includes:-

- Study production system of goat and sheep
- Different feed treatment technologies on performance of sheep and goat
- Improvement of sheep and goat breeds through selection and cross breeding
- Alternative starter feed formulation and housing management to reduce lamb and kid mortality
- Epidemiological investigation on Causes and risk factors of young stock morbidity and mortality in sheep and goats in Eastern Ethiopia
- Identification of causes and risk factors of reproductive disorders affecting performance of sheep and goats in Eastern Ethiopia
- Investigation of internal parasites dynamics for application of strategic interventions in Eastern Ethiopia
- Impact of PPR and CCPP in sheep and goats Eastern Ethiopia

1.4. Camel Productivity Improvement in Eastern Ethiopia

Though camel production is well-known in Eastern Ethiopia, milk and meat productivity is very low. There is poor milk handling practice and high post-harvest loss; genetic and management problems that hampered camel productivity; camel Trypanosomosis (Surra) is a common cause of morbidity and mortality and there is an indiscriminate use of anti-trypanocidal drugs; camel calf morbidity and mortality are common; external parasites are highly prevalent and there is little or no information on vector borne diseases. Thisresearch area focuses on:

- Studies on quantitative and qualitative genetic parameters on camel
- Selection and evaluation of camels for economic traits
- Post-harvest handling and improving the shelf life and quality of camel milk and milk products
- Epidemiological study of Surra (vector and host range identification and also seasonal dynamics)
- Design and implement integrated control and prevention methods for Surra
- Epidemiological study of external parasites (Tick and mange mites) and design and implement suitable control and prevention methods
- The epidemiological investigation of camel calf morbidity and mortality and implementation of appropriate control and prevention methods
- Select the best intervention methods for Surra, camel calf morbidity and mortality, and external parasites

1.5. Apiculture in Eastern Ethiopia

Apiculture is well-known and economically viable farming activity in Eastern Ethiopia. However, honey production is very low. Moreover, there is poor honey handling practice and high post-harvest loss; genetic and management problems that hampered bee productivity and disease of bee. The priority research focus includes

- Introducing and evaluating different species of bee
- Improving feed resource and water availability for apiculture
- Introduce different technologies for apiculture
- Select the best intervention methods for disease of bee and beehive

1.6. **Dairy Productivity Improvement in Eastern Ethiopia**

Diary production is an integral component of farming systems in Eastern Ethiopia. However, lower capacity of the local dairy cattle for milk production; limited selection and genetic improvement program for high milk production within indigenous cattle; the lower efficiency of reproductive

technologies like AI and synchronization; poor calf and heifers husbandry limited future dairy replacement and expansion; higher mortality of calves; poor milk handling and post- harvest loss; poor technological intervention to improve the local available low quality feeds; shortage of feed and poor capacity to feed using scientific feeding system; mastitis and other diseases that cause reduced milk production are common in the area. Moreover, there are no clear control and prevention methods for clinical and subclinical mastitis in dairy farms; the problem of drug resistance among mastitis causing organisms is increasing; causes of calf morbidity and mortality are unknown, and there are no clear control and prevention strategies; the incidence and causes of reproductive disorders are unidentified. Hence, the following are identified as the research focus area:

- Genetic improvement of local dairy cattle through selection and breeding
- Effect of feed treatment on milk production and milk quality
- Evaluation of improved forage species for milk production and milk quality
- Milk handling and reducing post-harvest loss, and the role of gender in urban dairy production
- Assessment of calf and replacement heifers husbandry practice
- Evaluation of Estrous synchronization protocol and effectiveness of artificial insemination
- Epidemiological study of mastitis and associated factors in Eastern Ethiopia
- Design appropriate control and prevention method for mastitis
- Perform drug sensitivity test and selection of effective groups of drugs
- The epidemiological investigation of Calf morbidity and mortality
- Design and implementation of appropriate control and prevention methods for calf morbidity and mortality
- Investigation of the major causes of reproductive disorders, design and implementation of appropriate mitigation strategies.

1.7. Beef Productivity Improvement in Eastern Ethiopia

Beef production is very common among the smallholder farmers of eastern Ethiopia. Low productivity of the local cattle breeds; limited selection and genetic improvement program for beef production within indigenous cattle; ongoing Ogaden cattle breed improvement program show promising results but not yet finalized and need to be selected and distributed to the final beneficiaries; lack of comprehensive information on carcass quality and yield, only piecemeal approach research results are reported; there are identified potential cattle breeds (Ogaden, Babile, Boran) for beef production, but are not well characterized and evaluated in terms of beef productivity , meat quality and meat yield.; shortage of feed and poor capacity to feed using scientific feeding system; feedlot performance of breeds like Babile is lacking; and use of inappropriate animal for beef production (old and over-matured animals) that will produce tough and poor quality meat are among beef production and productivity challenges. Hence, the fous of this research area includes:

- Genetic improvement of local cattle breeds (particularly Ogaden, Babile and Boran) through selection and breeding
- Effect of different feeding regimen on performance, carcass yield and meat quality
- Evaluation of carcass yield, meat quality of local cattle breeds in the region
- Evaluation of meat processing technologies in the region and evaluation of its safety
- Epidemiological study of beef cattle diseases in the region

1.8. **Hide and skin management in Eastern Ethiopia**

Hide and skin production is known to generate a reasonable amount of foreign currency. However, low quality hides and skin; absence of market and market chain of hide and skin; absence of value

addition and limited selection and genetic improvement program for improving hide and skin production within indigenous animal are among the many constraints of hide and skin production. Therefore, under this research area the following research priorities are identified:

- Genetic improvement of local animal breeds for hide and skin through selection and breeding
- Effect of different feeding regimen on performance, and quality of hide and skin
- Evaluation of marketing system for hide and skin
- Introduction of hide and skin storing techniques
- Establishing hide and skin marketing chains

Sub-theme 2: Plant Production and Health (PPH)

Research on PPH has been conducted for several decades and encouraging results have been obtained both at regional and national scales. However, the crop production and productivity is constrained with many problems in Eastern Ethiopia. The climate change, erratic rainfall, recurrent drought and moisture stress in Eastern Ethiopia need to be addressed through technologies generated by researches. Researches may not address all the problems of crop production and productivity of the region in a short period of time and therefore problems that need urgent solution have been identified in each research area.Efforts have been made by research teams to address the identified problems with research projects; and high priority research projects are selected. These projects are mainly focused on development of technologies for drought tolerant and moisture stress, farmers' participatory selection of technologies, development of technologies for multi-constraints and multi-cycle production, crop protection, germplasm enhancement and maintenance, quality seed multiplication, characterization and evaluation of fruit crops, neglected crops, plant species, indigenous trees and shrubs, as well as medicinal and aromatic plants. Thematic research approach has been attempted to apply in the process of identifying high priority research projects. The importance of professionals' participation from wide range of fields of specializations and the establishment of multidisciplinary teams in each research project should be considered for the success of the projects.

2.1. Field crops research area

2.1.1. Participatory Evaluation of Cultivars, Production Packages, and Integrated Pest Management of Sorghum in Eastern Ethiopia

Sorghum is the major crop produced in Eastern Ethiopia. However, the production and productivity of the crop is very low due to frequent drought, moisture stress and short growing season brought about by the global climate change. Disease and pest problems associated with the crop also need to be addressed. Promotion of production packages compatible with the production system are also among the major production constraints. Therefore, participatory evaluation of cultivars, production packages, and integrated pest management of sorghum are the research priorities in Eastern Ethiopia. The research components are:

- Participatory evaluation and development of improved sorghum varieties in eastern Ethiopia
- Developing sorghum hybrid seed for different agro ecological areas of eastern Ethiopia
- Development and evaluation of sorghum hybrids for Striga resistance in eastern Ethiopia
- Participatory evaluation and identification of moisture stress tolerant and early maturing sorghum varieties for eastern Ethiopia
- Development, Participatory Evaluation and Selection of Integrated Pest Management for Sorghum in Eastern Ethiopia.

2.1.2. Generation and Promotion of Maize Technologies in Eastern Ethiopia

In Eastern Ethiopia, the major problems in maize production and productivity are drought,

moisture stress, disease and insect pest. There are also less fertilizer and integrated nutrient management package trials for this commodity which require due attention. The adaptability of maize varieties with enhanced nutritional qualities (protein quality, Pro Vitamin A and improved feed traits) in Eastern Ethiopia have not been tested at large and farmers have not participated in selection of maize technologies. The following research components are identified as high priority to address the problems within a short period of time. Components under this research area are:

- Evaluation of responses of maize to newly released blended fertilizers
- Evaluation of the responses of maize to integrated nutrient management
- Participatory evaluation and promotion of improved maize varieties at different agro-ecologies of eastern Ethiopia;
- Assessment of ecological distribution of parasitic- and non-parasitic weeds, maize stalk borer, plant diseases and pest, and development of integrated weed, disease and pest management in eastern Ethiopia, and
- Improved agronomic management options for maize production in Eastern Ethiopia.

2.1.3. Development of Technologies for Small Cereals that fit to eastern Ethiopia

The production of wheat, teff and barley is low and they have low contribution to the agriculture sector in Eastern Ethiopia. However, farmers' interest to produce these crops is increasing. This crop production in Eastern Ethiopia is mainly constrained by unavailability of crop varieties adaptable to the region, disease and pest, and abiotic stresses. Soil fertility problem is also among factors affecting the productivity of these small cereals. The following research components are believed to address the major problems. The research components under this are:

- Evaluation of responses of each small cereal crop to newly released blended fertilizers
- Evaluation of the responses of each small cereals to integrated nutrient management
- Identification of disease resistant, high yielding and wide adaptable wheat, teff and barley varieties in Eastern Ethiopia;
- Development of integrated weed, disease and pest management for wheat, teff and barley in Eastern Ethiopia;
- Development of improved agronomic practices for wheat, teff and barley and farmers' participatory evaluation of technologies in Eastern Ethiopia

2.1.4. Integration of Technologies to Alleviate Multiple Constraints of Lowland Pulse Crops Production in Eastern Ethiopia

In Eastern Ethiopia, the production of lowland pulses has multiple advantages including the compatibility of crops to the existing intercropping crop production, enhancement of soil fertility, withstanding drought and moisture stress, providing protein rich food to the community and cash income as an export commodity. However, the production of these crops is constrained by multiple problems, and production agroecology shift is observed due to climate change that is not addressed by the University and National Project researches. The severity and frequency of drought also cannot be tackled with the existing lowland pulses species. The tackling of these problems requires identification of varieties to mid and high land altitudes, introducing drought tolerant species, alleviating disease and pest management problems, and demonstration of lowland pulses products. Components are:

- Adaptation and farmers' participatory selection of common bean varieties in mid and highlands of Eastern Ethiopia;
- Demonstration and farmers' participatory selection of drought tolerant mung bean varieties and cowpea genotypes for food security and income generation in Eastern Ethiopia;

- Characterization and product development of common bean, cowpea and mung bean in Eastern Ethiopia;
- Testing of the compatibility of mung bean varieties in existing intercropping crop production system in Eastern Ethiopia;
- Integrated management of diseases, insect pests and weeds of common bean, cowpea and mung bean in Eastern Ethiopia.

2.1.5. Integration of Technologies to Alleviate Multiple Constraints of Highland Pulse Crops Production in Eastern Ethiopia

A number of faba bean, field pea, chick pea and lentil improved varieties have been developed and released nationally, combining diverse plant type with resistance or tolerance to several diseases, insect pests, and parasitic weeds and possessing other good agronomic traits. However, farmers in Ethiopia are reluctant to adopt them, with only 3-5% of the cultivated land covered with seeds of improved crop varieties. Shortage of seed of improved varieties, lack of attributes desired by farmers, low information exchange between farmers and researchers about the improved varieties, biotic and abiotic factors constrained production and farmers' uncertainty about the improved varieties or risk-aversion could be the major reasons for the low adoption rate of improved crop varieties. The production and productivity of grain legumes is constrained by several biotic and abiotic factors. Therefore, to enhance grain legumes productivity and utility, integrated and applied research should be give due attention in Eastern Ethiopia.Research components are:

- Evaluation of responses of selected highland pulse crops to newly released blended fertilizer;
- Participatory evaluation and selection of improved varieties and agronomic practices of fababean in Eastern Ethiopia;
- Participatory evaluation and selection of improved varieties and agronomic practices of field pea in Eastern Ethiopia;
- Participatory evaluation and selection of improved varieties and agronomic practices of chick pea in Eastern Ethiopia;
- Participatory evaluation and selection of improved varieties and agronomic Practices of lentil in Eastern Ethiopia;
- Survey, identification and integrated management of diseases, insect pests and weeds of faba bean in Eastern Ethiopia;
- Survey, identification and integrated management of diseases, insect pests and weeds of chick pea (*Cicerarietinum*) in Eastern Ethiopia;
- Promoting production and utilization of faba bean, chick pea, field pea and lentil for improved nutrition and health in Eastern Ethiopia;

2.1.6. Enhancing Groundnut and Linseed Productivity and Production in Eastern Ethiopia

Eastern Ethiopia is among the major groundnut producing regions in the country. The crop has a potential to alleviate food and nutrition security problems. It is also a high potential crop as export commodity that will be a good opportunity to generate additional income to poor farmers in moisture stress areas of lowland Ethiopia. However, the production and productivity of the crop is constrained as a result of either unavailability of technologies to farmers. In addition, Aflatoxin contamination limited export to international market. These problems have not been well addressed by the National Research Project in Eastern Ethiopia. Therefore, Haramaya University needs to take the responsibility in alleviating the problems. Though the alleviation of the problems requires a long term research, the research team has identified the short term research activities in this project. The research components are:

- Integrated management of Aflatoxin Contamination in Groundnut;
- Scaling up of groundnut Sheller in Eastern Hararghe;
- Scaling-up of improved groundnut varieties through Community based Small-Scale Seed Production Scheme in East Hararghe ;
- Training on Groundnut product development for enterprises and smallholder farmers
- Trainings and preparation of aflatoxin management guideline
- Pre-scaling up of groundnut technologies in major-growing areas of Eastern Hararghe
- In-vitro selection of groundnut (*Arachis hypogea* L.) genotypes for resistance against *Apergilus*species (*Aspergillusflavus*and *Aspergillusparasiticus)*
- Development of disease resistant, high yielding and wide adaptable linseed varieties in eastern and western Hararghe;
- Development of improved agronomic practices for linseed production in eastern and western Hararghe;
- Popularization and seed multiplication of improved linseed varieties in eastern and western Hararghe;

2.2. Horticultural crops research areas

2.2.1. Assessment, Development and Promotion of Technologies for Underutilized Crops: Emphasis to Okra, Chaya and Amaranthus

Ethiopia is claimed to be the origin of Okra. The highly mutinous Amaranthus is grown as weed in the country. The production of Okra is only in pocket area of the country but grown as a wild plant at large in the country. Okra and Amaranthus can be potential to food and nutrition security in the country; the crops withstand moisture stress and potential export crop (particularly Okra). However, technologies have not been developed for these crops in the country and are not included in the National Research System. But Haramaya University has started to address the problem since the beginning of this decade. However, the successes of the past efforts of the University depend on the continuation of the started research activities which are listed below. The focus areas are:

- Assessment of the genetic diversity and potential utilization of Amaranthus germplasm in Ethiopia;
- Characterization and evaluation of Ethiopian and exotic Okra genotypes for tender fruit and seed yield and quality;
- Demonstration and farmers' participatory selection of exotic Amaranthus varieties in Eastern Ethiopia;
- Development and demonstration of Okra and Amaranthus products, and characterization of nutritional contents.

2.2.2. Development of Potato Technologies for Sub-optimal Irrigation Production in Eastern Ethiopia

The farmers in Eastern Ethiopia are producing potato with two and three production cycles in a year using local cultivars with short dormancy period under sub-optimal irrigation. The local cultivars are disease susceptible and cannot be used for main cropping season. However, the improved potato varieties have long dormancy period that cannot be used for successive production under irrigation. Neither the University nor the National Research System had addressed these issues to alleviate the potato production system in Eastern Ethiopia. But the interlinked production

problems are not to be tolerated anymore due to the production of the crop below its potential in the region as results of under optimal irrigation water application aggravated with climate change, the ever increment of production area and the demand of the farmers for technologies that fit the production system. Therefore, the following research activities have been identified as urgent to alleviate the potato production problems in Eastern Ethiopia. The research components are:

- Identification of potato cultivars that produced high tuber yield under sub-optimal irrigation water;
- Assessment of tuber yield reduction due to sub-optimal irrigation water and the changing climate;
- Assessment of potato production constraints under sub-optimal irrigation water;
- Development of integrated technologies fit to potato production system in the changing climate in Eastern Ethiopia.

2.2.3. Collection, Characterization and Evaluation of Fruit Crops in Eastern Ethiopia

In the current agriculture, Eastern Ethiopia has not contributed much to the production of fruit crops. The tragedy is that the declining fruit production status of the region is due to production constraints not addressed by research. The University needs to address the critical fruit production problems before fruit production become nonexistent in the region. Though it is known that fruit research requires decades and huge amount of investment, research activities are identified as stepping stones as follows. The research components are:

- Establishment of orchard for research, demonstration and training;
- Assessment of fruit crops production constraints in Eastern Ethiopia;
- Collection, characterization and evaluation of fruit crops importance to the region ;
- Collection, characterization, evaluation and conservation of fruit crops varieties in Eastern Ethiopia.

2.2.4. Development of Potato Technologies for Multiple Cycles and for Multipurpose in eastern Ethiopia

Potato is co-staple food, the second most important crop next to Khat and market oriented to export in eastern Ethiopia. Most farmers living in this region have small land about quarter a hectare and produce potato throughout the year under irrigation. However, this multiple cycle production is suffering by lack of disease resistant, early maturing varieties and with short tubers dormancy period. Due to these farmers produce potato from local cultivars during dry and "belg" season which are susceptible to disease during "meher". In addition, the local cultivars are producing tubers with low dry matter content not suitable for processing. The region is known with iron and zinc malnutrition in Ethiopia where the existing potato genotypes do not have sufficient amount of these minerals. The research in the University as well as in the nation did not produce technologies fit the potato production system in eastern Ethiopia. The seed tubers used for production are poor quality, not produced for the purpose at separate farms and tubers produced with unlimited generation from the source planting materials that leads to high disease degeneration and reduction of yield year after year. Therefore, research effort has to be made toalleviate these problems specific to the region by designing project that focus:

- Searching early maturing genotypes having short dormancy period, disease resistant with required tuber dry matter content suitable for multipurpose,
- Training of farmers on quality seed tubers production and establish demonstration fields for quality tuber seeds production,
- Generating technology for tuber dormancy breaking as alternative remedy measures, and

- Introduction and evaluation of biofortified potato genotypes (with iron and zinc) and develop potato varieties rich in mineral contents

2.2.5. Determination and Designing of Methods for Quality Processed Potato Products in eastern Ethiopia

Starting the introduction of potato, the crop was used for preparation of traditional foods such as "dinchwot", boiled potato etc. However, currently, tubers are processed to produce French fries, chips and others at small scale and flourishing in cities, big and small towns. But a toxic compound known as Acrylamide is produced in high heated starchy foods in which the products are possible carcinogen. The problem is becoming more critical when tubers with low dry matter content are fried with vegetable oils not to be used for chips and French fries processing for many cycles of frying beyond the optimum limit of temperature. Therefore, chips products by small business people are expected to have this toxic compound at high content. Therefore, it is necessary to design project focusing on the following research activities.

- Assessing the chips/potato processed products methods in eastern Ethiopia,
- Estimating the toxic substances in the end products of processed potato products,
- Evaluation of tubers used for processing under proper processing and traditional methods,
- Designing easy method(s) for identification of tubers for processing to be used by small business people,
- Generate policy brief to be provided to the regional government, and
- Producing manuals for healthy potato processing and provide training of small business people.

2.2.6. Introduction, Evaluation and Development of Sweet potato Varieties Rich in Minerals and Vitamins Contents

Haramaya University has released two Sweet potato varieties (Adu and Berkume) which are cultivated in eastern Ethiopia. Eastern Ethiopia is one of the known regions where chronic malnutrition of Fe, Zinc and Vitamin A are among the major problems of the society. Biofortified sweet potato genotypes rich in Fe, Zinc and Vitamin A are developed elsewhere in the world and some of the genotypes are introduced in the country, therefore, it is possible to develop varieties for the region through introduction and evaluation. This will help to alleviate the malnutrition problems reaching to the rural community. Therefore, a project is required to be designed and executed focusing on development of varieties rich in Fe, Zinc and Vit. A through determination of nutrition quality of storage roots, development of products and postharvest handling of storage roots with the following major components of the research project.

- Introduction and evaluation of disease free biofortified sweet potato genotypes and development of minerals (Iron and Zinc) and vitamin (Vit A) rich varieties in eastern Ethiopia
- Determination of agronomic management (planting method, spacing and fertilizer rates) and postharvest handling for biofortified sweet potato varieties in eastern Ethiopia
- Determination of nutrition quality (Fe, Zinc and Vit A) of storage root of biofortified Sweet potato varieties in eastern Ethiopia under different agronomic management and locations
- Development of products from storage roots of biofortified sweet potato varieties.

2.2.7. Development of Agronomic and Postharvest Handling Management Packages for Shallot Bulb and Seed Production

Seed production from shallot is one of the most challenging tasks in horticulture crops and the researchers in horticulture are thriving to produced seed from this crop throughout the world. However, the researchers in the Haramaya University were capable to produce seeds from this crop successfully with uninterrupted efforts made for more than a decade. With the production of seeds from Huruta variety, the researchers also have a chance to improve the bulb yield through bulb-seed to bulb method. The variety is proposed for release as essentially derived variety of Huruta. However, the agronomic management of this variety has not yet developed. Therefore, it is necessary to develop packages to recommend this variety for cultivation at large areas of eastern Ethiopia. For the purpose, the research project is required to be designed and executed addressing the following major research components.

- Determination of fertilizer rates and spacing for improved Huruta shallot variety for bulb yield in eastern Ethiopia;
- Determination of fertilizer rates and spacing for improved Huruta shallot variety for quality seed and high seed yield production in eastern Ethiopia;
- Identification of optimum planting time, suitable location(s), bulb quality and bulb handling for quality seed and high seed production of Huruta shallot variety

2.2.8. Introduction, Evaluation and Generation of Technologies for High Value Vegetable Crops in eastern Ethiopia

The technologies demand is increasing for high value vegetable crops such as tomato, egg-plant and cabbage in eastern Ethiopia. However, the improved technologies for such crops are not available in sufficient quantity and quality. For some of the crops such as egg-plant, there are no improved varieties recommended in the country. The agronomic packages and postharvest handling of these crops are not developed for eastern Ethiopia in particular and in the country in general except for tomato. The shelf life quality andnutritional content of these crops need also to be determined to serve the purposes of end users. The problems can be addressed through introduction, evaluation and identification of adaptable high yielding varieties and generation of agronomic and postharvest handling technologies for eastern Ethiopia. Therefore, project need to be designed and executed focusing on the following major components.

- Evaluation of high yielding and disease resistant tomato varieties in eastern Ethiopia;
- Determination of fertilizer rates, spacing and other related agronomic management practices for tomato in eastern Ethiopia;
- Generation of postharvest handling practices to increase shelf life of tomato and determination of tomato varieties fruits physical quality and nutritional constitute;
- Identification of methods for quality seed extraction from improved tomato varieties easily adaptable by farmers in eastern Ethiopia;
- Introduction and evaluation of commercial egg plant varieties in eastern Ethiopia;
- Determination of fertilizer rates, spacing, postharvest handling and fruit quality of introduced egg plant varieties;
- Introduction and evaluation of commercial cabbage varieties in eastern Ethiopia;
- Determination of fertilizer rates, spacing, postharvest handling and head cabbage quality of introduced varieties

2.2.9. Postharvest handling technologies for eastern Ethiopia

High postharvest losses result in reduced food availability, lower quality foods, and lower nutritional value and/or food safety danger. Most of the past efforts in Ethiopia focused on development and dissemination of better yielding, disease resistant varieties for farmers along with production technology packages. But when production is boosted, prices will fall if there is no means to extend the shelf life via improved postharvest handling, cooling, cold storage or processing into more stable food products. But, the postharvest handling of most of the horticultural crops has not yet developed. The research priorities include:

- The effect of postharvest technologies on horticultural crops chemical compositions, physical quality, nutritional and sensory properties and acceptability by consumers
- Postharvest loss determination and training on improved postharvest technologies and facilities for storing and handling fresh produce from the point of harvest to consumer markets.
- Determining the efficacy of the appropriate postharvest technologies that can be used to extend product shelf-life for use in food processing industries (value-addition); and
- Awareness creation as well as transfer/dissemination of knowledge and skills on improved postharvest handling practices among the value chain actors (input suppliers, subsistent farmers, retailers, cottage and large-scale food processors) and experts working at grassroots levels on product storage best practices.

2.3. Crop protection research area

Plant protection forms one of the major components of crop production, as yield is obviously far lower than the potential of the crops due to plant diseases, insect pests, plant-parasitic nematodes and weeds. Susceptible food crops could totally fail while some others bear substantial yield loss due to these pests. In addition to yield loss in the field, food crops are also lost in transport and storage unless properly handled and managed. Despite the remarkable progress made in increasing food production at the global level, approximately half of the population in the Third World still does not have access to adequate food supplies. Evidence suggests that food losses occurring in the postharvest and marketing system tend to be highest in these countries where the need for food is highest. Both quantitative and qualitative food losses of extremely variable magnitude occur at all stages in the post-harvest system from harvesting, through handling, storage, processing and marketing to final delivery to the consumer. Fruit, vegetables and root crops are much less hardy and are quickly perishable, if care is not taken in their harvesting, handling and transport, and they will soon decay and become unfit for human consumption. Postharvest rotting of cereal grains and of legumes is also quite common and the losses caused by it are quite significant. Such losses occur primarily at the large bins or warehouses of the growers, wholesalers, or manufacturers and are seldom observed by the general public. Storage losses are both in quality and quantity to the extent that it becomes detrimental to human health.

Some of the pests are imported from other countries, as the quarantine system of our country is also poor. Containment of such exotic pests requires regular survey and research to recommend proper policy measures. The success of plant protection programs depends on the ability to detect pests. Detection schemes can be designed in different forms of regular surveys. That is, because well designed survey program includes regular monitoring for insect pests, diseases, weeds, nutrient deficiencies, irrigation problems, sanitation, and much more. Early intervention is instituted as soon as signs of damage are detected, rather than later when they are irreversible. Plants and pests are continuously confronted with each other during evolution in a battle for growth and survival. In this

rivalry plants have evolved a stunning array of structural, chemical, and genebased defenses, designed to combat the pests of different nature and, so as the some pathogens by developing new races. Many plants both in nature and in agriculture are resistant to multiple diseases. Although much of the plant innate immunity system provides highly specific resistance to pest organisms, there is emerging evidence to support the hypothesis that some components of plant defense are relatively nonspecific, providing multiple resistances. Understanding multiple resistances is of fundamental and practical interest to plant biologists, entomologists, pathologists, and breeders to reduce loss levels to pests. The overall losses in food have been further aggravated by losses in feed and fodders of animals. Such losses could be due to mycotoxin contaminations that request for immediate solutions. Accordingly, the major research priority projects with major research components are identified by Crop Protection Research Area.

2.3.1. Assessment of Crops Yield Loss and Sustainable Management of Plant-Parasitic Nematodes in eastern Ethiopia

- Damage assessment, population dynamics and management of root-lesion nematodes (*Pratylenchus* spp.) in major cereals crops of Eastern Ethiopia.
- Sustainable management of plant-parasitic nematodes on tomato, pepper, potato and sweet potato crops in Eastern Ethiopia;
- Damage assessment, identification and characterization of cereal nematodes in Eastern Ethiopia;
- Investigating diseases complexes involving plant-parasitic nematodes and soil-borne fungal pathogens on root, tuber and vegetable crops;
- The potential of entomopathogenic nematodes to manage economically important insect pests of major crops in Eastern Ethiopia.\

2.3.2. Assessment of Mycotoxin-Producing Fungi Distribution and Mycotoxin Contamination in Foods, Feeds and Fodders in Eastern Ethiopia

- Analyses of mycotoxin contamination in foods, feeds and fodders in Eastern Ethiopia;
- Importance and distribution of mycotoxin-producing fungi and their management in major Crops (especially focusing on legumes) in Eastern Ethiopia.

2.3.3. Assessment of Crops Yield Loss due to Insect Pests, identification and Management of Emerging and Re-Emerging Diseases, Insect Pests and Invasive Weeds of Major Crops in Eastern Ethiopia

- Plant diseases, insect pests and parasitic weeds monitoring on major crops in Eastern Ethiopia (Regular Survey);
- Importance and distribution of emerging and Re-Emerging diseases, insect pests and invasive weeds of major crops in Eastern Ethiopia;
- Pinning out the association of production systems and disease epidemics and insect pest outbreaks on major crops in Eastern Ethiopia;
- White mango scale *(Aulacaspustubercularis*), the newly emerging pest to Ethiopia
- Sustainable management of American fall army worm the newly emerging pest of Maize in Ethiopia
- Plant viral disease identification and management on major vegetable crops of Eastern Ethiopia.

2.4. Indigenous trees/shrubs, aromatic and medicinal plants research area

The important role played by indigenous trees and shrubs in natural forest, wood land, and agroforestrysystem in east Hararghe and their benefit to the environment, livelihoods of the local

communities and sustainable development is not well assed and documented. Medicinal plant plays an important role in pharmacology and pharmaceutical chemistry because of its high essential oil content in its different parts in herbal medicine; they are used for their antiseptic properties against infectious diseases of fungal and bacterial origin. However, little information is available about the medicinal plants in eastern Ethiopia. Therefore, the research project need to be designed and executed focusing on evaluation of the status of indigenous trees, shrubs and analyses of chemical composition and antimicrobial effects of extracts from different parts of medicinal plants in Eastern Ethiopia.

2.4.1. Assessing the Status of Indigenous Trees and Shrubs, Determination of Medicinal Values of Herbs and Medicinal Plants in eastern Hararghe

- Status and future prospects of indigenous trees and shrubs in eastern Hararghe
- Phytochemical and pharmacological investigations of extracts of different parts of selected herbs and medicinal plants in eastern Hararghe

2.5. Germplasm maintenance and enhancement research area

2.5.1. Germplasm Maintenance and Enhancement of Crops and Seed Multiplication of Crop Varieties

Haramaya University has been contributing a lot to the country in developing crops varieties since its establishment as Agriculture College. The germplasm collected by the University has been the basis for the establishment of national gene bank and thousands of collections were conserved as world wealth at different gene banks. However, the University has failed to maintain its own varieties, collections and introduced crops genotypes. The seed production of crop varieties in the University is not under strict supervision of breeders. Therefore, the following activities are proposed to be implemented every year. Some of the activities related to this research area are:

- Maintenance of enhancement of potato and sweet potato collections and seed tubers and cutting multiplication of commercial varieties;
- Maintenance of inbred lines and old maize varieties, and seed multiplication of commercial varieties;
- Maintenance of cereal crops germplasm and seed multiplication of commercial varieties**;**
- Maintenance of common pulse crops collections and seed multiplication of commercial varieties;
- Maintenance of collections and seed multiplication of commercial varieties of oil crops.

2.6. Urban and peri-urban agriculture research areas

There will be high rate of urbanization in African countries in the coming twenty years. Many of the countries in which there are fast urban growths are least-developed nations. These countries are not capable enough to provide sufficient food demanded by the expanding urban population via imports from rural areas. This leads to increased food insecurity and prevalence of poverty in the urban areas. For instance, Ministry of Finance and Economic Development for Ethiopia (2006) reported that urban population of Ethiopia will increase in two folds by 2020, and urban poverty is currently becoming a growing concern especially in large cities of the country. Thus, cities may need to consider agricultural production in urban areas or urban fringe to reduce the food insecurity and prevalence of poverty. Urban agriculture in Africa was evolved as a response to scant sources of urban economic sustenance i.e. insufficient supply of staple food to cities coupled with declining purchasing power of city dwellers. Currently, millions of urban dwellers are reinforced to restore

farming in urban areas throughout many African cities either to supplement their household income or because they cannot afford to meet their daily food needs.

Urban agriculture is not a phenomenon that is practiced only by urban people in African cities as their survival strategy. Deeltstra and Girardet (1999) have argued that it is also prominently being practiced in the developed world to supplement food imports. For instance, 40 % of agricultural production was obtained from urban farming in US in 1990, and there were 80,000 urban community gardeners in Berlin in 1999, as it was made evident by Deeltstra and Girardet (1999). Thus, understanding the role that urban agriculture plays in poor urban households is important for any following action to reduce urban food insecurity and improve income of the urban poor.Urban agriculture includes agricultural productions such as horticulture, floriculture, forestry, fishery, poultry and livestock mainly in public open spaces within cities and fringe of cities (Deelstra and Girardet, 2004 and Mougeot, 2000). It uses resources, products and services of the city area, and it provides the same. It is viable for efficient urban land use, poverty alleviation, economic development and environmental management as long as it is mainstreamed into urban livelihood policy strategies (Maxwell, 1999 and Mougeut, 2000).

Despite the fact that the growth and development of urban agriculture is an economically viable enterprise, official projects and programmes aimed at improving urban agriculture have been relatively rare. This is typically because urban agriculture has not been taken as an integral part of the urban planning process. As a result, no sufficient data are collected on urban agriculture nor does the activity have any identity or validation as a productive sector of the economy in countries like Ethiopia. Urban development planning has tended to neglect urban agriculture over the years. This has led to lack of supportive services to the sector. Urban agricultural practices are underdeveloped. They have not been developed to suit the changing demands for better technology. Urban agriculture has not been encouraged and given its rightful place in the economy. For example, there are no extension services available to the urban farmers. Presently there is no stated policy regarding urban agriculture in Ethiopia. The research components are:

- Evaluating the status of Urban and Peri-urban agriculture in Eastern Ethiopia
- Assessment of constraints of UA and PUA in Eastern Ethiopia
- Assessment of the farmers perception on the use of UA and PUA for the food security and urban and peri-urban food self-sufficiency
- Developing, demonstrating and adopting different technologies of Urban and Peri-urban agriculture to help achieve food security

Sub-theme 3: Environment, Natural Resource and Climate Change

3.1. Natural Resource Analysis, Use and Management

Natural resources support the livelihoods of many poor people. However, there is scarcity of scientific knowledge to identify and addresses problems related to conservation and characterization of major natural resources such as soils, forests, biodiversity and others. Therefore, research project need to be designed and executed to understand the status of natural resources in eastern Ethiopia. The major components of the research project are:

- Soil characterization, classification and mapping in Eastern Ethiopia
- Assessment of fertility status and mapping of the soils in Eastern Ethiopia
- Assessment of the status of forest resource and other vegetation in in Eastern Ethiopia
- Assessment of the status of vegetation ecosystem in Eastern Ethiopia

- Assessment of ecosystem goods and services and their contribution to poverty alleviation in Eastern Ethiopia
- Vegetation watershed management and rehabilitation strategies in Eastern Ethiopia
- Factors influencing vegetation cover and their distribution in Eastern Ethiopia
- Monitoring and characterization of biodiversity
- Analyze the actual and potential values of biodiversity
- Predict the future cause-effect relations between biodiversity challenges and drivers
- Explore and predict the role of the biodiversity c in global changes mitigation

3.2. Water resources assessment, development, utilization, and management

The hydrology of eastern part of Ethiopia is based on river, wetland and lake systems. Water from these rivers, lakes and wetlands is becoming insufficient to meet the eastern Ethiopia's growing needs. Currently, eastern Ethiopia is facing serious water crisis in the form of water scarcity for domestic, agricultural and industrial use. However, water resource of eastern Ethiopia is not well studied. They have been overexploited for different purposes without having knowledge on the occurrence, distribution, flows and quality of the groundwater systems. Therefore, detail hydrologic, hydro geologic, and water use and management investigations are needed in the region and the nation as a whole, for sustainable use of the water resources.

- Assessing surface and groundwater resource potential
- Mapping the spatial and temporal distributions of groundwater and surface water resources
- Examining alternative water sources development
- Examining current and future water management challenges
- Assessing the current and future water demand
- Analyzing the cause and consequences of water use conflicts
- Developing water Harvesting Systems/Technology Development

3.3. Environmental research, development, and management

Water pollution has become a growing concern in eastern Ethiopia over the last century as more and more waste is being disposed of in our rivers and lakes. This increase in pollution is harming our food supplies, drinking water and environment. Pollution of water sources from haphazard disposal of solid wastes, discharge of untreated or inadequately treated wastewater to water sources, lack of standard sanitary facilities and poor hygienic practices. A major concern of the presence of polluting elements in the aquatic environment is related to the negative health effects they may cause in humans, animals, and plants. Research components are:

- Environmental pollution assessment,
- Estimation of pollution level and extent,
- Assessment of pollutant dynamics in the environment
- Studying methods to reduce pollution of water resources
- Urban solid waste management (plastics, electronics, others)
- Urban liquid waste treatment and management

3.4. Climate Change and its management

Of all the places Ethiopia, eastern Ethiopia and its societies, ecosystems, and agricultural systems are one of the most vulnerable to the effects of climate change. Despite the urgent need to assess the effects of changing climate, current climate predictions, impact assessment and management approaches for eastern Ethiopia are uncertainties. To address this need, research is needed. Research components are:

- Examining the relationship between human activity and climate change
- Examining impacts of climate change to agriculture, water, soil and ecosystem
- Developing climate friendly technologies and practices
- Developing regional climate change models to for assessing the risk of climate change
- Researching the socio-economic impacts of climate change and proposed adaptation and mitigation strategies
- Researching the role of biodiversity in climate change mitigation and developing of acceptable methods for inclusion of biodiversity conservation in carbon trading schemes
- Development of technologies for the production of bio-energy and other bio-products from agricultural and forest biomass
- Examination of soil carbon dynamics in forests