Sub-theme 1.2. Plant Production and Health

Rationale

Ethiopia has diverse agro-ecologies, agro-biodiversity and water resources, and great potential for agricultural production including food security crops, cash crops, industrial crops, tropical and sub-tropical vegetable and fruit crops, indigenous forests, medicinal plants, forage crops, etc. However, the country has been facing recurrent food shortages. This is because production technologies of the crops have not been improved and yields have remained low compared to the increasing population. In this respect, per capita food production and gross domestic product need to be increased through utilisation of improved agricultural technologies and innovations.

The low crop production and productivity in Ethiopia in general and the eastern parts of the country in particular is attributable to a number of complex and inter-dependent production constraints. These include limited access to agricultural inputs, improved crop production technologies, irrigation, and agricultural markets, as well as inefficient market value chains. In addition, soil degradation and nutrient depletion, ravages of pests and diseases as well as weeds are major obstacles to crop productivity and quality. Crop productivity is constrained further by uncoordinated technology transfer, extension, weak partnerships and institutional linkages as well as low rate of adoption of improved technologies. Besides this, the rich plant biodiversity of the country has not been wisely utilized and preserved.

Little efforts have been made to improve productivity and quality of crops through introducing, enhancing, and breeding of crops and improving agronomic practices as well as through transfer of appropriate knowledge and technologies.

Aim

The aim of this sub-theme is to undertake research related to improving plant productivity, quality, and health.

Description

Conducting research on priority crops through exploring and utilisation of genetic potentials and manipulating environmental conditions through appropriate agronomic and cultural practices including technologies that help to optimize the profitability and sustainability of cropping systems are among the major activities under this sub-theme. These include variety selection, plant breeding, weed management, tillage, crop rotation and selection, and management of plant nutrients in the soil.

Molecular (marker assisted selection) and tissue culture techniques in variety development, and producing disease free propagating materials are also the targets of this sub-theme. Likewise, enhancing availability of improved seed and other propagating material through integrated seed sector supply systems, also falls under this sub-theme, as do landscaping and floriculture.

Particular focus will be given to food security crops, fruit corps, vegetable crops, cash crops (coffee, oil crops, etc), fibre crops (cotton), sugar crops (sugarcane), industrial crops (sisal, kenaf) and beverage crops under this sub-theme.

Potential Collaborators

National organisations such as the Ethiopian Institute of Agricultural Research (EIAR), Ministry of Agricultures (MOA), Institute of Biodiversity Conservation (IBC), Oromia Agricultural Research Institute (OARI), Somali Regional Pastoral and Agro-pastoral Research Institute (SoRPARI), regional agricultural bureaus, Ethiopian public universities, Swedish International Development Agancy (SIDA), overseas universities such as Wageningen University, Swedish University of Agricultural Sciences, Langston University, Oklahoma State University, and other international research organisations such as Consultative Group on International Agricultural Research (CGIAR) centres (CIP, ICARDA, ICRAF, IFPRI, CIAT, CIMMYT, IITA), smallholder farmers, private farmers, and private enterprises.

Expected Output

- Newly improved crop varieties
- Quality food
- Efficient and sustainable agronomic management practices
- Improved post-harvest handling technologies, value adding crop varieties and products.
- Collected, characterized, evaluated and conserved germplasm for use in hybridization and genetic diversity.
- Available options for a diversified cropping system
- Improved production, processing, and management knowledge and technologies for export crops.
- Appropriate technologies for improving soil fertility, problematic soils, disease, insect pests and weeds that enhance crop production
- Quality seeds and other propagation material of food and cash crops for enhanced productivity and incomes
- Improved crop pest and disease management practices

Research Areas

1.2.1. Field crops

Research shall be directed towards increasing the productivity of high priority crops in ways that enhance environmental services and build social resilience for transforming production systems. This research area focuses on development and promotion of improved field crop varieties, management practices, soil fertility/problematic soil management practices, pest and disease management, and post-harvest handling. It also focuses on ensuring the nutritional, processing and export qualities of the crops. Research will be done to mitigate mycotoxin contaminations and post-harvest management of sorghum, groundnut, maize, and other

crops. In general, research on each crop will focus on variety development, pest and disease management, production management/agronomy, processing, and alternative uses of the crops.

Research shall also be undertaken to address the following issues: dissemination, and better utilisation of higher yielding varieties of priority food, fibre, oil, fibre crops (cotton), sugar crops (sugarcane), industrial crops, and beverage crops; enhancing productivity and efficiency of locally adapted crop systems; developing tools of system-wide, value-chain analysis; undertaking classification of climatic, soil, water, and other physical characteristics of specific geographies; enhancing nutritional, processing and export qualities of the crops; and examining the potentials and specific challenges of urban agriculture.

1.2.2. Horticultural crops

The priority crops in this research area are vegetable crops, root and tuber crops, fruit crops, mushrooms, and cash crops. The improvement of horticultural crops deals with developing varieties and technologies for rain-fed and/or irrigation agriculture, for problematic soils, and for export and local consumption. This research area also deals with the nutritional, processing, and export quality of produces, post-harvest handling, landscape and floriculture.

Research shall be conducted on root and tuber crops (potato, sweet potato, carrot, etc.), mushrooms, leafy vegetables (cabbages, tomato, pepper, onion etc), tropical fruit crops (mango, banana, citrus, cherimoya, papaya, etc), and sub-tropical and temperate fruit crops (peach, plum, apple etc). The research shall generally focus on variety development, pest and disease management, production management/agronomy, value addition, processing, and alternative uses of the crops.

1.2.3. Harar coffee

This research area focuses on improvement of coffee genetics, agronomy, processing, and postharvest management for sustainable production and quality enhancement. The research area also deals with coffee nutrition as well as pest and disease management for enhanced

organic coffee production. It also deals with developing a database on the extent of contamination of coffee with pesticide residues, heavy metals, and mycotoxins. Developing methods for effective management of these contaminants and educating the growers and processors on these vital issues through research and extension are also among the focus areas of this research. The research area also deals with quality standards and value addition of coffee.

1.2.4. Spices

Ethiopia in general and eastern Ethiopia in particular, has agro-ecologies suitable for production of annual and perennial spices: *Capsicum* (hot pepper), cumin, fenugreek, coriander, black mustard, rosemary, koseret (*Lippia* spp.), rue, basil, and others.

This research area focuses on developing high yielding and high quality spice varieties, conserving genetic resources of spices, and protection systems using traditional and non-traditional techniques. It is also important to develop post-harvest technologies of spices with emphasis on product development and product diversification for domestic and export purposes. The research area also deals with monitoring and adoption of new and existing technologies to make sure that research is targeted to the needs of the farming community.

1.2.5. Bio-energy plants

The research area focuses on bio-energy plants which are essential as an alternative energy source in terms of replacing petroleum-based energy and reducing long-term carbon dioxide emissions. Some plant species have high potential in producing bio-fuel; among these plants, castor bean (*Ricinus communis*), Ethiopian mustard (*Brassica carinata*), Vernonia (*Vernonia galamensis*), and Jatropha (*Jatropha curcas*) are the promising plants in eastern Ethiopia. Thus, this research area addresses problems related to the development of improved varieties and production packages, identification of potential areas and productivity of bio-fuel plants and their utilisation.

1.2.6. Industrial crops

This research area deals with aspects of improving production and productivity of crops such as sugarcane (*Saccharum officinarum*), cotton (*Gossypum hirstum*), tobacco (*Nocotiana tabaccum),* sisal (*Agave sisalina*), etc.

1.2.7. Forage crops

This research area deals with improvement of forage crops. It also deals with the nutritional, processing, post-harvest handling, and feeding technologies of the crops. Furthermore, the research area focuses on improving indigenous and exotic grass and legume forage species for sustainable forage seed production, preservation, and utilization.

1.2.8. Indigenous trees/shrubs and medicinal/aromatic plants

This research area deals with domestication, improvement, and utilisation of indigenous forest, fruit, aromatic, and medicinal plants. It also deals with the nutritional, processing, post-harvest handling, value addition, and marketing of the products.

1.2.9. Soil fertility, quality, and productivity

This research area focuses on ensuring long-term productivity of soil, through finding ground breaking fertiliser technologies that increase production while preserving soil integrity. Research is also done to improve knowledge about the specific soil protection, remediation, health and fertilizer needs of the country. This research area also includes optimizing mineral nutrition of plants, thus striving for optimum, environmentally sound, sustainable, and efficient fertilisation technologies and practices (including integrated nutrient management, carbon sequestration, use of crop rotations, bio-fertilisers etc). It also focuses on identifying soil amendments and practices that facilitate fertilizer uptake and minimise nutrient losses; studying nutrient use and nutrient cycling in cropping systems; investigating genotypic differences in nutrient uptake and use efficiencies; developing rapid appraisal methodologies to identify the physical, social, political, economic, and other constraints to improved soil

fertility. It also deals with cataloguing and developing paths to utilize effective and appropriate soil nutrient management to increase soil health and provide resilience from weather shocks.

1.2.10. Plant diseases, pests, and weeds

This research area deals with the study of the biology, ecology, epidemiology, diagnostics, and management of major diseases (late blight, rusts, smuts, root rot, etc.), pests (insect pests such as army worms, locusts, birds, storage pests, etc) and weeds (including invasive weeds such as *Parthenium spp., Prosopis juliflora, Lantana camara, etc* and parasitic weeds such as *Striga spp., Oroanche spp.*, etc. and grass weeds) of crops, forests, rangelands and water bodies in different agro-ecologies as well as development of crops resistant to pathogens.

The research area also includes disease pathology which involves mechanisms of resistance and susceptibility of crops to diseases caused by fungi, bacteria, viruses and nematodes; epidemiology/microbial ecology: biology of pathogens (life cycles, interactions with other microorganisms, effect of environment) in the laboratory, greenhouse, and field; modelling/statistics involving development and delivery of plant disease prediction models (disease forecasting); application of decision theory to the management of diseases of crops; molecular genetics/genomics; disease resistance; transfer of agronomically important genes from wild relatives of crops to cultivated crops; development, molecular cytogenetic characterisation, and maintenance of germplasm stocks.

It also focuses on assessing the distribution and impact of invasive weeds, management of invasive weeds through utilisation of compost, bio-fertilizers, and insect bio-agent (e.g. *Zygogramma bicolorata*).

1.2.11. Germplasm enhancement and maintenance

The focus of this area is germplasm enhancement through collection, characterisation, evaluation, hybridization and maintenance. It also deals with improving plant genetic resources through conventional plant as well or molecular marker techniques. Emphasis will be given to

sorghum, coffee, groundnut, maize, wheat, pulses, potatoes, barley, fenugreek, cassava, teff, finger and pearl millets, rice, sesame, etc.

Beneficiary

Farmers, scientific community, government, policy makers, industry, research institutions, and the wider public.