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Ministry of Science and Higher Education - Ethiopia

MINISTRY OF SCIENCE AND HIGHER EDUCATION

**NATIONAL AGRICULTURE RESEARCH PRIORITY THEMATIC
AREAS**

Addis Ababa
September 2021



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1. Background

The Ethiopian economy is mainly dependent on agriculture, which had exhibited 9.1% average annual growth during 2014/15-2018/19. The growth reflected a mix of factors, including agricultural modernization, development of new export sectors, strong global commodity demand and government-led development investments. The agriculture sector is projected to grow at 6.2 percent per annum over the next ten years (International trade administration, 2021). The growth in real GDP was mainly attributed to 11% growth in services, 3.8% in agriculture and 12.6% in industrial sectors (NBE, 2020). Agriculture contributes 27.5 billion dollars (34.1%) to the GDP, employs about 79% of the population, accounts for 79% of foreign earnings, and it is the major sources of raw material and capital for investment and market (MoA, 2019).

Ethiopia's development plan has laid out enhancing agricultural production and productivity as one of the major strategic pillars. In addition, the ten-year development plan aims at boosting agricultural export revenues and substituting imports by reducing production costs. This can be achieved through leveraging huge unutilized arable land, modernizing production systems, and improving uptake of technology. Furthermore, the ten-year plan envisages to build a climate resilient green economy. In this regard, Ethiopia pursues to expand development efforts to fight land degradation and to reduce pollution; reduce Green House Gas (GHG) emissions; increase forest protection and development; increase production of electricity from renewable sources for domestic use and for export; and focus on modern and energy saving technologies.

The contribution of agriculture to GDP growth in 2019/20 was 22.9 percent of which crop production accounted for 65 percent, followed by animal farming & hunting (25.9 percent) and forestry (8.8 percent) (NBE, 2020). The livestock sector contributed up to 40% of agricultural GDP, nearly 20% of total GDP, and 20% of national foreign exchange earnings in 2017 (FAO, 2019) Over the past decade, cereal production has more than doubled to nearly 15 million tonnes. Nevertheless, food security remains a critical issue for many households and the country as a whole.

The major causes of food insecurity in Ethiopia can be accounted to reliance on rain fed agriculture (only 5% of land in Ethiopia is irrigated), critical shortage and untimely distribution of agricultural inputs (improved seeds and animals, fertilizers, pesticides, lime, animal feed), mechanization, shortage of credit system, weak market linkage and unwise natural resource management. These problems need to be resolved through integrated research.

Similarly, livestock productivity has been challenged by several factors as low quantity and quality of feeds and feeding, genetic potential; healthcare system and management. The scope of change made in processing, storage and packaging technologies of the products has led to high post harvest losses. Furthermore, deforestation and unwise use of natural resources has led to land degradation, climate change and overall loss of major biodiversity.

The main objectives indicated in the 10 years development plan of the ministry of agriculture are; market-oriented agricultural production, reduction of post-harvest loss, use of improved technologies, plant protection and animal health, product quality and safety, sustainable use and management of natural resources, and product marketing (MoA, 2021). Therefore, research priorities primarily considered addressing these strategic objectives which in turn address societal issues specifically related to the enhancement of livelihoods and societal development. This necessitates the establishment of a system for integrating experienced and emerging young researchers with enabling environments, as well as the establishment of well-defined research priorities, rigorous research project proposal approval systems, efficient research administration, appropriate resource allocation, effective coordination, and sustained capacity building. The end products of research (knowledge and technologies) must be disseminated and evaluated on a regular basis. The following policies and strategies guide the formulation of national agricultural research priorities:

- The Pathway to Prosperity Ten Years Perspective Development Plan (2021 – 2030)
- Ten years Agricultural development plan
- National Science policy and strategy
- Sustainable development goals particularly;

- No poverty (SDG 1)
- Zero Hunger (SDG 2)
- Good health and wellbeing (SDG 3)
- Goal 5: Achieve gender equality and empower all women and girls
- Clean water and sanitation (SDG 6)
- Climate action (SDG 13)
- Life below water (SDG 14)
- Life on land (SDG 15)
- SDG Goal 12.3- Responsible consumption and production

With this understanding, research priorities in agriculture are expected to lead to:

1. Enhanced agricultural productivity, efficiency, increased income and employment, with the overall improved livelihood through novel technologies, management of biotic and abiotic stresses, water and biodiversity resources;
2. Reduced post-harvest losses through increased efficiency in food and non-food products harvesting, processing, storage, distribution and supply chains;
3. Increased technology up-take through effective technology transfer system, sustainable provision of extension services, extension agents and farmers' education and public outreach programs;
4. Diversification of agricultural products export and food sources by addressing the socio-economic and cultural factors that limit their acceptance;
and
5. Promoted sustainable products' utilization; natural resources conservation and management; indigenous knowledge; environmental management and governance; mitigation and adaptation to climate change.

Accordingly, this document identified seven national agricultural research priority thematic and sub-thematic areas within each, which are summarized below.

2. Major Priority Research Thematic Areas

The major thematic areas identified under agriculture research are livestock production and health; crop production and management; agricultural mechanization; soil and water management; forest, biodiversity and climate change; soci-economics, extension and agribusiness and crosscutting issues. The details for each major theme and their subthemes are discussed below.

2.1. Livestock Production and Health

Ethiopia has the largest livestock population in Africa contributing significantly to its economy as most of the population relies on rearing livestock. According to the recent report by CSA (2021), the livestock population in Ethiopia is estimated to be 70 million cattle, 42.9 million sheep, 52.5million goats, and 57 million chickens, 8.1 million camels.

Despite the enormous potential and increasing livestock population, the productivity and product quality have been challenged owing mainly to poor genetic resources, poor quantity and quality of feeds and health care system contributing to the huge demand and supply gap. On the other hand, due to increasing urbanization, income and human population, the demand for milk and meat is expected to exceed by 145 and 257 percent increase, respectively, with similar or higher growth rates for the demand for other animal source foods (FAO, 2019). Earlier assessment from the livestock master plan shows that with a few interventions, such as research and technology transfer at various scales of livestock farms, livestock production and productivity can be increased tenfold.

Accordingly, the theme focuses on animal production and management including healthcare system towards increased livestock production and productivity. Hence, the following are sub-themes under livestock production and health;

- Animal genetic resource improvement and conservation

- Biotechnology applications in animal improvement
- Veterinary public health (zoonotic diseases, food borne disease, food safety, and non-food borne diseases and tuberculosis, etc.)
- Emerging and persistent diseases and pests
- Epidemiology of infectious and non-infectious animal diseases
- Animal diseases prevention and control strategies
- Animal Husbandry and welfare
- Animal feeds and Nutrition
- Improving pastoral and agro-pastoral animal production and productivity
- Rangeland and livestock water Management
- Ranch-based livestock management
- Livestock product quality and safety, (handling, and processing of meat, milk, hide and skin, horn, honey, egg, etc.)
- Fishery and other aquatic life
- Intensive beekeeping system
- Livestock marketing and supply chain management

2.2. Crop Production and Management

Under this document, the word crop includes cereals, pulses, oil seeds, horticultural crops, stimulants and spices. Crop production and productivity are constrained by variety of problems including lack of access to agricultural inputs, improved crop production technologies, credit services, irrigation, and agricultural markets, as well as inefficient market value chains. In addition, land degradation and soil nutrient depletion, and climate change and variability, ravages of persistent and emerging crop pests and diseases are major obstacles to crop productivity and quality. Crop production is also constrained further by uncoordinated technology transfer, extension, weak partnerships and institutional linkages and a low rate of adoption of improved technologies.

Research on crop production has been going on for several decades and encouraging results have been obtained at a national scale. However, majority of the released varieties did not reach farmer needs and aspirations in different parts of the country. This implies that farmers' participatory selection and evaluation of released varieties need to be conducted to select varieties that are suitable to the specific area within a short period. The use of improved agricultural technologies and innovations will increase per capita food production and gross domestic product.

Over the last few years, the government of Ethiopia has been committed not only to increasing the production and productivity but also to developing the horticulture sector and enhances the production and productivity of horticultural crops. Horticulture development corridors have been identified in different parts of the country. These corridors are endowed with suitable environmental and edaphic conditions that are suitable for the production of fruits and vegetables like banana, avocado, citrus, onion, tomato, potato, etc.

Crop production in Ethiopia has been increasing for more than two decades. However, less emphasis has been placed on the protection of pre-harvest and post-harvest grain and horticultural products. This leads to a large portion of the output is being lost before it reached human consumption. In Ethiopia, small-scale farmers' grain and horticultural products have sometimes suffered a huge loss. Insects, molds, and diseases could all be to blame. Particularly mycotoxin has been reported in different parts of Ethiopia which caused stunting in children and cancer in adults. Reducing post-harvest loss and maintaining grain quality and safety will help the country's mission to reduce grain import and enhance food self-sufficiency. Such issues necessitate research at a national level in order to make the best use of what the country has produced.

Hence, thematic-based research is imperative to increasing the productivity of major food, industrial and cash crops nationwide. Therefore, the following national priority thematic research areas in crop production and management have been identified.

- Crop genetic resource improvement and conservation
- Biotechnology applications in crop improvement
- Crop protection
- Crop management and cropping systems
- Post-harvest technology and management (threshing, cleaning, storage, milling, packaging, baking, etc)
- Horticulture crops improvement (fruits and vegetables, root and tuber crops, spices and herbs and medicinal plants, ornamental plants and cut flowers, stimulant plants like coffee and tea)
- Post-harvest technology and management of horticultural products (such as cold chain supply system)
- Crop and horticultural products marketing and supply chain management
- Product quality, safety and nutrition improvement
- Agro-processing and value addition

2.3. Agricultural Mechanization

Agricultural mechanization deals with the use of any improved mechanical aid in agricultural production. These mechanical aids could be simple hand tools, animal-drawn implements, or sophisticated mechanically powered agricultural machines. The productivity of each type is determined by the power source. The source of energy ranges from humans, animals to the engine or electrical power. Humans being inefficient, one can hardly cultivate a hectare of land per season, whereas animal-powered technology is of no use beyond three hectares. However, mechanical-powered technology is good enough to cultivate a minimum of 40 hectares even in sub moist zones where the window of operation time does not exceed 15 days (Firew, 2015).

Agricultural mechanization needs to be sustainable and must take economic, social, environmental, cultural, and institutional settings into account. In Ethiopia, several imported and locally manufactured machinery appear to be of sub-standard quality and unsuitable for agricultural production operations, among others, due to a lack of standardized testing and evaluation mechanisms. Currently, the country lacks a full-fledged independent national testing

center dedicated to providing a quality assurance service for agricultural machinery and implements. Hence, it is high time to revisit or set up an autonomous national agricultural machinery testing and evaluation and certification center to ensure the safety, quality, and suitability standards of agriculture machinery and implements. The local capacity, logistics and other infrastructures need to be in place to successfully produce/assemble machinery locally. Hence, the government needs to commit to strengthening the personnel, financial, and material resources capacity of education, research and development institutions engaged in agricultural mechanization (EAMF, 2020).

Currently, the existing research centers are conducting mechanization/agricultural engineering/research on pre-harvest, harvest, and post-harvest technologies, fabrication of prototypes, pre-scaling up of technologies and demonstration, provide training on the use, operation, and handling of the technologies, providing consultation on agricultural engineering/mechanization/research, provide testing and evaluation of agricultural Engineering/mechanization/technologies either imported or modified locally; evaluation of the different irrigation systems, evapotranspiration, and crop water requirements are among the major once. However, many of the technologies developed are seldom adopted by the users as most of them are not feasible economically, structurally, socially or culturally. Therefore, the followings are the major thematic areas for further research.

- Design and prototyping of farm implements (tillage equipment, planter, harvester, sprayer, thresher, cleaner, storage, etc.) and
- Design and prototyping of livestock production and product processing technologies
- Forest engineering and mechanization (clear-felling, processing, etc.)
- Solar-powered storage for preserving perishable products
- Renewable energy production and utilization
- Development of mechanized irrigation system
- Development of water harvesting technologies
- Development of packaging and storage technology

2.4. Soil and water management

Soil and water are the major natural resources that affect agricultural productivity. Soils across different agro-ecologies in Ethiopia are impeded by various problems that constrain their contribution to agricultural productivity. Soil erosion and nutrient depletion have been identified as the major challenges that adversely affect soil fertility and crop production. Soil acidity, alkalinity, salinity, and vertisols are problematic soils that are unable to support agricultural production.

Ethiopia is endowed with ample water resources including 12 river basins with an annual runoff volume of 122 billion m³ of water and an estimated 2.65 billion m³ of groundwater potential (MoA, 2011). However, the agricultural system does not fully engage improved technologies for irrigation and water management (Awulachew *et al.*, 2011). As a result, smallholder farmers dependent on rain-fed agriculture are vulnerable to food insecurity and poverty, especially in times of erratic rainfall.

The adoption and implementation of modern and feasible irrigation technologies are important to improve the livelihood of the rural community. Currently, Ethiopia is constructing large- and small-scale dams for power and irrigation purposes in different agro-ecologies. The government, donors, and NGOs are investing in developing irrigation systems, especially on small-scale irrigations. As a result, irrigation is developing rapidly. However, its contribution to the national economy is not significant when compared to rain-fed agriculture. There is lack of detailed study regarding water potentials and their developmental perspectives in the Ethiopian context.

To maintain and improve agricultural production, physical and biological soil and water conservation, land reclamation, and fertility maintenance and enhancement measures are critical. The best way to reclaim soils and water bodies should be through appropriate land-use planning and integrated watershed management. Such an approach is critical for addressing resource degradation issues and achieving food self-sufficiency, which is the agricultural development program's long-term goal.

Research interventions are indispensable to generate appropriate technology and information that could solve the problems indicated above. Therefore, the major national priority research sub-thematic areas related to soil and water management are expected to deal with:-

- Land use and land cover
- Ground water resources assessment, development, and utilization
- Soil and water conservation and management
- Integrated watershed development and management
- Sedimentation and siltation problems in water bodies
- Integrated soil fertility and nutrient management
- Management of problematic soils (Acidity, alkalinity, salinity, sodicity, vertisol, etc.)
- Carbon sequestration and reduction of greenhouse gas emissions
- Wetland management;
- Irrigation water quality management, water use efficiency and irrigation methods
- Development of irrigation scheme
- Economics of irrigation water use
- Water resource use conflicts and their resolution

2.5. Forest, biodiversity and climate change

The forest resources of Ethiopia have been a life-supporting system of the population for the last several centuries. The farming community, comprising 85% of the Ethiopian population, depends on forest products and services for its day-to-day life activities. The major products include fuel wood, construction materials, timber and non-timber forest products. However, due to deforestation and the unwise use of forest resources, the land is exposed to run-off which led to soil erosion, loss in soil fertility and biodiversity. Therefore, conservation of the existing natural forests must be given much attention and the establishment of plantation forests using afforestation or reforestation is extremely important. Wubalem *et al.*, (2019) reported that the total area of plantation forest in Ethiopia was estimated to be 972,000 ha.

Biodiversity is the variation of life forms within a given ecosystem, biome, or for the entire Earth. Biodiversity is responsible for providing essential functions and services that directly improve human life. They are responsible for maintenance of the gaseous composition of the

atmosphere, regulation of the global climate, generation and maintenance of soils, recycling of nutrients and waste products, and biological control of pest species. Ecosystems surely would not function if all species were lost, although it is unclear just how many species are necessary for an ecosystem to function properly. However, human activities, such as direct harvesting of species, introduction of alien species, habitat destruction, and various forms of habitat degradation (including environmental pollution), have caused dramatic losses of biodiversity. These threats are also common in Ethiopian condition.

Ethiopia is vulnerable to the adverse impacts of climate variability and change due to its location. Current climate variability is already imposing a significant challenge to Ethiopia by affecting food security, water and energy supply, poverty reduction and sustainable development efforts. Sensitivity and adaptive capacity also vary between sectors and geographic locations, time, socioeconomic and environmental considerations within a country.

Therefore, continuous research has to be conducted to alleviate such problems and assure benefit gain from the potential forest and wildlife resources, conserving biodiversity and contributing to ecotourism development. It is also important to generate information on climate change mitigation, adaptation, modeling and risk management to build a resilient economy and society. Thus, the national priority sub-thematic areas in forest, biodiversity and climate change include:

- Plantation forestry
- Agro forestry
- Forest health and protection
- Forest product innovation and utilization (Timber and Non-timber forest products)
- Sustainable management and conservation of natural forest and plantation;
- Wildlife management and ecotourism
- Biodiversity conservation, management and utilization
- Urban and peri-urban forestry
- Climate change vulnerability, impacts, adaptation and mitigations strategies

2.6. Socioeconomics, Extension and Agribusiness

In Ethiopia, agricultural extension is playing a crucial role in agricultural development and rural transformation. The extension is understood as a policy instrument and legitimate tool for a government to bring about desired changes in political, socio-economic, cultural and environmental aspects (Emelie, 2021). The evident goal of agricultural extension is to help farmers to overcome agriculture-related constraints by improving knowledge, skills, and attitudes and persuading them to adopt/adapt and use innovations.

Making agricultural extension demand-driven remains a challenge in Ethiopia. While there is a strong political will to expand agricultural extension in Ethiopia, the strong standardization of extension packages arising from a pronounced top-down nature of public service delivery makes it difficult to tailor agricultural extension to farmers' needs (Tewodaj *et al.*, 2009).

The effort of research and development of new or improved technologies suitable for local agro climatic environments and their dissemination is considered the most important means to boost agricultural production and improve the well-being of farmers in Ethiopia. Adoption of improved varieties generally has positive effects on yield and farmers' welfare.

Agribusiness involves all the steps required to send an agricultural good to market; production, processing, and distribution. The major problem in the Ethiopian context is poor linkage among value chain actors, unfair profit sharing, mismatch between demand and supply, absence of binding rule and regulation between value chain actors.

These issues require research and evidence-based resolution to commercialize Ethiopian agriculture. The followings are the major sub-thematic areas for further research.

- Optimal resource utilization and production system
- Quality goods, services and technologies
- Market, agribusiness and enterprise development (input market, output market, labour market, value chain analysis, Small, medium and other agribusiness development, etc.)
- Dissemination and scaling-up of technologies and best practices (commercialization clusters, farmers' field/business school, etc.)

- Adoption and impact assessment (linkage, networks, innovation platform analyses, system impact analysis, etc.)
- Agricultural inputs supply and system development (agrochemicals, animal feeds, fertilizers, quality seeds and planting material, farm implements and equipment)
- Poverty, livelihood, and food and nutritional security
- Agri-food systems/circular economy analysis and management
- Macroeconomic dynamics and stability
- Valuation of agricultural resources and contribution to GDP (Forest, crop, livestock, wildlife, etc.)

2.7. Cross-cutting issues

Ethiopia's national priorities include food security, poverty reduction, gender equality, social inclusion, job creation and ensuring sustainable use of the environmental resources are the national priorities of Ethiopia. Despite, numerous efforts made so far, the country is still suffering from critical food shortage and a substantial proportion of its population lives in poverty necessitating empirical evidence in order to design appropriate interventions and attain middle-income status by the year 2025. Social inclusion including women in agricultural production, the wise use of natural resources and environmental protection is no more a choice. The lack of recognition of women's roles in agriculture is a serious issue that can be described as a perception bias. Given the importance of gender, social inclusion, nutrition, climate change and genetic resource in all the different themes under agriculture the plan is to mainstream these issues in all the themes. Indigenous knowledge, which has been embodied in the socio-cultural setup, has been marginalized for several decades. There has recently been greater focus on identifying and developing it.

Research on quarantine system, and policy frameworks towards innovation system, marketing, agricultural communication, and knowledge management, are critically lacking thorough investigation. Alternative food/feed source and safety researches are also in their early stages.

Addressing all the above issues is critical for improving the all-around development of rural livelihoods and resilience.

Therefore, the national agricultural priority sub-thematic areas related to cross-cutting issues will focus on the following;

- Gender, youth and social inclusion
- Indigenous Knowledge (identification, validation, documentation, and use)
- Quarantine system (bio security)
- Policies, Institutions, and Governance
- Innovations Systems
- Agricultural marketing and trade challenges (import substitution and export competitiveness)
- Alternative food and feed sources (plant and animal origins)
- Agricultural communication, Knowledge and Information management
- Climate-smart agriculture, rural livelihoods and resilience
- Digitization of Agricultural system
- Precision agriculture

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