

Theme VI- Basic Sciences Research Thematic Area

Sub-theme 1: Bioscience Research

Eastern part of Ethiopia is rich in plant, microbe and animal diversity. Biodiversity provides ecosystem services, and forms an integral part of the rural economy, providing subsistence, goods and medicines. However, research on biodiversity, particularly from the point of view of their ecology and conservation status; use to the local people and potentials for pharmaceuticals and industrial purposes; responses to abiotic and biotic stresses are lacking. As a result, biodiversity is being lost together with indigenous knowledge of people around them. The biosciences research sub-theme, therefore, set out a research priority to study ‘Plant, Microbial and Animal Biodiversity’ from the following specific project components standpoint. Accordingly, the following priority research areas have been suggested for the 2024/25 Call for Proposals

6.1 Plant, Animal and soil microbial communities’ ecology and environment conservation.

- Documenting plant and wild animal species and their distribution pattern in eastern Ethiopia
- The interaction of plants and animals with natural environment and their responses to abiotic and biotic stresses.
- Conservation status and development of conservation mechanisms for biodiversity in eastern Ethiopia
- Impact of climate change on soil microbial communities and develop management strategies.
- Climate change mitigation and carbon financing
- Identifying new microbial-based tools for soil remediation

6.2 Isolation, identification and characterization of harmful and beneficial microorganisms.

- Genomics and metagenomics of harmful and beneficial microbiota
- Isolation and characterization of microbes for biofuel production.
- Study the microbial dynamics in agriculture and environment

6.3 Agricultural Biotechnology

- Production of novel enzymes for various application.
- Biofertilizer development and production from agricultural wastes
- Tissue culture on commercial crops and endangered species
- Assessment of the nutritional quality of cattle fed with drug supplements vs local feed only
- Research on fish resources and fish oil development

Sub-theme 2. Chemical Science Research

Synthetic materials have many applications in medicine, pharmaceuticals, food, construction, manufacturing industries, etc. Ethiopia is rich in resources (biological and non-biological) that can be used as input in material science and synthesis. The rich biological resources we have are opportunities to use natural products in an array of applications provided that efficient scientific methods of extraction, screening and isolation are put in place. With this great potential, a great deal of research are required to advance knowledge in areas of material science using local resources that would inevitably be used to generate technologies for various applications. The Chemical research sub-theme, therefore, set out the following research priority for 2024/25 Call for Proposal.

2.1 Method development

- Analytical methods for detection of heavy metals, pesticides, polycyclic aromatic compounds, mycotoxins, and emerging contaminants (e.g. nanomaterials, drugs, etc.);
- Development of biosorbents, and other materials for the treatment of various wastes such as sewages, and industrial discharges (influent, and effluent).
- Methods for real-time tracking and analysis of nanomaterials their transformation products in the environment and the biota, and mechanisms of nanomaterials toxicity.
- Synthesis of green solvents (e.g. ionic liquids, supercritical fluids, etc) and adsorbents (e.g. nanomaterials, biosorbents, composites, etc.).

2.2 Microplastics and E-waste on the environment and the biota

- Microplastics transformation products and processes (in freshwater, lake water, and soil compartments).
- Electrical and electronic waste, and plastic waste analysis
- Plastic recycling and plastic degradation.

2.3 Drug design and development from medicinally important organic molecules

- Extraction, isolation and structural elucidation of bioactive natural compounds, investigating their *in-vitro* effects and mechanisms of actions for potential pharmacological, medical or therapeutic applications.
- Study structure-activity and enzymatic inhibition mechanisms relationships.
- Mechanisms of drug action and the molecular basis of disease prevention.
- Development of environmentally friendly nanoscale therapeutics devices for drug delivery systems.
- Development of healthcare products and drug from medicinal plants

2.4. Material development and characterization

- Repurposing animal skins (development of technologies for animal skin processing Production of chemicals for skin tanning from local materials)
- Development of alternative packaging materials from low-cost materials for food items
- Development of water purifier equipment from local materials
- Quality packaging materials development from nanomaterials or nano-coating

Sub-theme 3. Mathematical Research

Mathematics provides the framework for understanding almost any complicated phenomenon. Advanced mathematical techniques are used to model and test products on computers, optimize production techniques and have interplay with various systems. Advancing mathematical research helps to build strong scientific community capable of technology generations and new innovations. Despite its immense role, research in mathematics is not being conducted to its best level. Thus, recognizing the importance of mathematical researches to the building of strong scientific bases

for technology generations and innovations, the Mathematical Research Sub-theme set out the following research priority for 2024/25 Call for Proposal.

3.1 Modern Techniques for Optimization and Operations

- Investigations of heuristic approaches like genetic algorithms, simulated annealing, particle swarm optimization, ant colony optimization, fuzzy optimization, and neural-network-based methods and their application in solving real life optimization problems.

3.2 Mathematical modeling for infectious and non-infectious diseases

- Predicting and projecting prevalence of infectious and non-infectious diseases

3.3 Numerical Methods for Solving Differential and Integral Equations

- Developing numerical methods for solving differential and integral equations that are used for modeling different real-life phenomena (such as flooding, earthquakes).

3.4 Mathematical Methods for Artificial Intelligence, Machine Learning and Data Science

- Developing algorithms and deep learning techniques for artificial intelligence and machine learning
- Developing computational methods for analyzing and interpreting (big) data in agriculture, health and etc.

Sub-theme 4: Biophysics and Computational Physics

Computational physics develops algorithms that are of immense use in industries and medical issues. Research output on material computation can serve as an input to any nanoscale related research to improve the efficiency of the material for energy generation, waste treatment, sensors and so on. Biophysics looks for mathematical laws of nature and makes detailed predictions about the forces that drive idealized systems in living things. In spite of immense industrial and environmental applications research works are scanty so far in Ethiopia. Cognizant of enormous use of Biophysics and Computational physics research in industries, environment and medicine, the Biophysics and Computational Physics Sub-theme the following are identified as priority research areas for 2024/25 Call for Proposal.

4.1 Computational and quantum information physics

- Algorithm development, simulation and evaluation of its accuracy and computational speed, image processing, machine learning, disease prediction and severity determination, parallel computing
- Quantum information technology (developing quantum based applications for AI)

4.2 Particle physics, (radiation physics, nuclear physics, and medical physics)

- Develop semiconductor detectors and dosimeters for clinical applications in radiation protection, radiation oncology and nuclear medicine as well as high energy physics applications.

4.3 Exploration Geophysics

- Measuring, modelling, prediction or mitigation of natural hazards (volcanoes, earthquakes, floods, droughts, landslides, etc.)
- Geophysics and seismology (distinguish the earth's numerous boundary layers)
- Geophysics and machine learning techniques/technology in modelling and mapping the impact of climate change on current and future water demand.
- Deep learning techniques/technology and artificial intelligence (AI) in predicting earthquakes, air pollution, Geospatial Analysis, etc.