# Call for PhD scholarships 2022 - 2027

In the framework of the AMU Institutional University Cooperation with Belgian Universities

Introduction

The Institutional University Cooperation (IUC) project between Arba Minch University (AMU) and five Belgian universities that started in 2017, is now preparing for a second phase from 2022 to 2027. The objective of the project is to contribute to the international recognition of AMU as a Centre of Excellence in Natural Resource Conservation Research, building capacity and providing service in the field of community health care, soil and water management, agriculture, value chains, aquatic and terrestrial biodiversity. The knowledge and skills gained by all involved in the program should become an element in the transformation of livelihoods in the Southern Regions to become equitable, healthy and sustainable. The project is financed by the Belgian government, through VLIR-UOS.

The project is made up of 7 subprojects, each with their own focus and expertise:
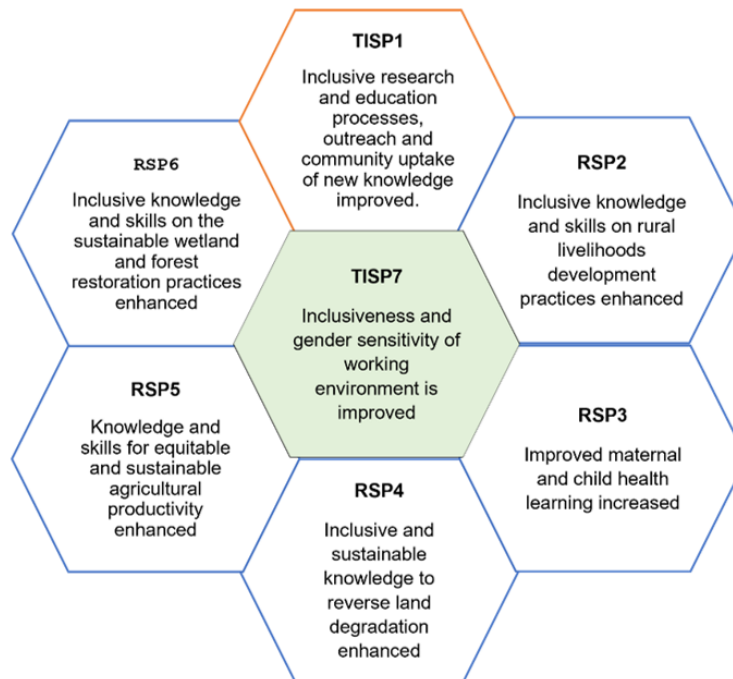
With this call, the project wants to **recruit a motivated and diverse group of 12 PhD scholars**, with a high interest in quality research and the potential to become change makers for Arba Minch University and the community at large.

Offer

Applicants are supposed to be, or to become, staff members of AMU. To achieve the aims of the project, all PhD scholars will be fully deloaded from any administrative and academic duties at AMU except for a 3 credit hour teaching which is mandatory to reinstate their full salary as academic staff.

He/she will be automatically re-instated when coming back to AMU for research and shall be receiving the full local salary.

PhD scholars working under the IUC project are entitled to stays in Belgium for **a total maximum of 24 months** (depending on each subproject's policy) to attend necessary courses, receive any relevant trainings and academic support, and focus on thesis writing.

He/she will receive half of local salary up to four years while in Belgium for more than two months.

While abroad, he/she will receive a scholarship allowance according to VLIR-UOS scholarship guidelines from the IUC budget. These guidelines are currently being finalized and still need to be confirmed by the donor VLIR-UOS, so the following amounts may still be liable to changes:

- Monthly allowance while in Belgium for PhD scholarship: 1.900 €

In some cases **a predoctoral period** of up to 6 months may be required to demonstrate and improve the necessary skills for the PhD trajectory. In that case the following is foreseen:

- Monthly allowance while in Belgium for Predoctoral scholarship: 1.500 €
- Indirect travel costs: 200 €

Every PhD scholar will have a promotor from one of the Belgian universities, and receive a PhD degree from that university at the end of a successful scholarship. In some cases he/she will also have an AMU local promotor.

The project strives for a 40-60% general balance for scholarship attribution to men and women. As it has proven difficult in the past to reach sufficient eligible female candidates, the project strongly encourages female members of staff to apply. In case of two equally qualified candidates, preference is given to candidates increasing the diversity of the group of selected PhD scholars.

Application procedure

The selection of PhD scholars will take place in two rounds.

1. **Preselection** by an ad hoc **AMU scholarship committee** with a composition paying special attention to gender balance and IUC experience.

   Candidates will be preselected by AMU scholarship committee based on the following requirements/case

   - Background relevance to specific sub project PhD call
   - Proficiency in English/ English Medium of Instruction
   - Validity of the MSc degree
   - The applicant should not be registered in any national and international PhD program
   - Any legal discipline case with AMU

   Applications in the form of a CV and motivation letter should be submitted by e-mail to the AMU Academic and Program Office (academic.programs@amu.edu.et) Cc: AMU-IUC program office and Belgian coordination (globalminds@kuleuven.be)

   Do mention clearly what topic(s) you will be applying for (see topics below).

   Deadline for submission is on **6 May 2022, before midnight**.

2. **Final selection per subproject** by the subproject leaders

   The preselected candidates will be contacted soon after the initial deadline for an oral and/or written interview or test by the subproject leaders. They will make a final decision on the selected scholars and report to the project administration accordingly.

   The topics and requirements per subproject can be found below. More details about the content and the requirements can be found in the annexes.

	Subject	Requirement
P1	Agent-based data fusion to support Ethiopian healthcare	MSc Computer Sciences or related
	Proof Logging for Maximum Satisfiability	MSc Computer Sciences or related
P2	Understanding land- and migration-based rural livelihoods in Southern Ethiopia	MSc Economic Sciences

	Migration and livelihoods: reshaping families, family matters, kinship and human security among the Gamo of Southern Ethiopia.	MA in Social and Cultural Anthropology.
P3[1]	Multi-pronged interventions to improve maternal and reproductive health in South Ethiopian rift valley and assessment of social determinants of health.	MSC Reproductive Health / Maternity Nursing / Health Services Management / Epidemiology or related
	Improving micro-nutrient gap in diet to improve the nutritional status of teenage girls in the South Ethiopian rift valley	MSc Human Nutrition / Public Health or related
	Maximizing the gains from proven malaria prevention measures and breaking transmission of malaria from index case to accelerate elimination of malaria in the South rift valley	MSc Public Health / Epidemiology and biostatistics / Tropical and Infectious Diseases / Medical microbiology / Medical Parasitology or related
	Improving the clinical management of cutaneous leishmaniasis in the south Ethiopian: A Randomized Controlled Trail and assess socio-economic impacts among the communities of CL endemic areas of south Ethiopian rift valley.	MSc Health Sciences or related
P4	Soil and water conservation measures to reduce land degradation at sub-catchment scale	MSc Soil science, Soil and Water Conservation Engineering, Watershed Management, Water Resources Management, Hydrology, Geography and Environmental studies, Soil and Water management, Natural Resources Management or related
	Modelling sediment and water budget in the current and future climate for Lakes Abaya and Chamo	MSc Hydrology, Water resources and Hydraulics engineering, Water resources and Irrigation Engineering, Water Resources Engineering, Watershed management, Water resources management, Soil and water conservation engineering, Soil and Water management or related
P5	Optimization of strategies to soil fertility management and plant material development of Enset to reduce the impacts of bacterial wilt	MSc horticulture, MSc agronomy, MSc applied biology, MSc agricultural sciences or related
	Feed preservation and ration formulation interventions for milk yield performance	MSc Animal Nutrition, MSc animal production, MSc agricultural sciences (Range ecology and management), MSc Bio engineering, Agricultural sciences or related *Candidates with a master's thesis in animal nutrition are given special consideration.

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[1] For this project two out of the four topics will be selected for financing depending on the availability and quality of the candidates

P6	Application of Remote Sensing in Aquatic Ecology: Lake dynamics in response to human impact and restoration.	MSc in GIS and a background on aquatic ecology or related
	Ecosystem Services Provisioning by Agroforestry Practices in the Lowlands of the South Ethiopian Rift Valley	MSc Agronomic ecology or related

Annexes

Additional information on PhD topics and requirements per subproject

Subproject 1

TISP1 Topic 1: Agent-based data fusion to support Ethiopian healthcare

Maternal mortality, malaria, tuberculosis, and HIV/AIDS are among the prevalent problems of the Ethiopian healthcare sector. The limited number of experts, medical supplies, and health institutions challenges access to proficient healthcare services, particularly in rural communities. And **low-cost and smart digital solutions** provide immense potential for healthcare professionals to tackle these problems.

In resource-constrained settings, **Artificial Intelligence** assisted solutions can play a pivotal role in different healthcare services including patient diagnostics, such as **knowledge base or expert systems** that emulate and complement the diagnostic decision-making ability of medical experts.

Therefore, the PhD research project strives to bring together computer science and health experts to identify, design, and apply novel AI techniques or **machine-learning algorithms** using structured and unstructured medical data sets (e.g., images, sensor data, health records, and etc.), to address local and pressing issues including detection or prediction of anemia, improving psychiatrist-patient interactions, diagnosis of leishmaniasis & diarrhea, model-based diagnosis, and detection of iron deficiency, and verbal autopsy diagnosis, as well as scientific advancement in the areas of **deep learning, natural language processing, image processing, and telemedicine**.

TISP1 Topic 2: Proof Logging for Maximum Satisfiability

Hard search and optimization problems are often solved by techniques of increasing complexity. As these optimisation technologies are increasingly being used for high-value and life-affecting decision-making processes, it becomes vital that we can trust their outputs—and unfortunately, current solvers do not always produce the correct answer. The most promising way to address this problem appears to be to use **certification**, or **proof logging**, where a solver must produce an efficiently machine-verifiable certificate that the solution given is correct. This approach has been successfully used in the Boolean Satisfiability (SAT) community, with numerous proof logging formats such as RUP, Trace Check, DRAT, GRIT, and LRAT. However, currently used methods support only **decision** problems, and do not capture the full range of SAT solving techniques.

The purpose of this project is to take the next leap forward for proof logging, by studying **optimization problems.** More specifically, we will study a range of solving techniques from the domain of **Maximum Satisfiability** (maxsat), such as **core-guided methods** and **hitting set-based** methods and investigate certification methods for them. We will investigate how the developed techniques can benefit the Ethiopian Healthcare system.

Subproject 2

Topic 1: **Understanding land- and migration-based rural livelihoods in Southern Ethiopia**

Description of the topic: In many parts of rural Ethiopia poverty is a persisting problem. The poor often derive the largest part of their income from cropping (i.e. land-based rural livelihoods) but are excluded from services and innovations that can improve their land and labor productivity. Due to population growth and increased pressure on land rural households increasingly seek alternative or complementary income sources, leading to outmigration from poverty-struck areas (i.e. migration-based livelihoods). The poor are risk-averse and make conservative production and labor allocation decisions that result in low income levels, persistent inequality, and food and energy insecurity. In the second phase of the VLIR-IUC project at Arbaminch University, researchers from Ethiopia cooperate with universities in Belgium to better understand land- and migration-based livelihoods in Southern Ethiopia and identify solutions to combat rural poverty and associated problems of (gender) inequality, and food and energy insecurity. The project is seeking a PhD candidate to cooperate in this project and pursue a PhD in agricultural and development economics in a sandwich system with Arbaminch University in Ethiopia and the University of Leuven in Belgium.

The PhD candidate will investigate research topics related to land-titling and the adoption and impact of land conservation technologies; household behavior towards risk and the implications towards poverty and food and energy security; and the push and pull factors for rural out-migration and its impact on poverty, income mobility and inequality. The PhD research will rely on primary survey data and quantitative micro-economic and econometric methods. The PhD candidate will build on a comprehensive household survey database that already includes two rounds of survey data collected during the first phase of the VLIR-IUC project among 900 rural households in six districts in the Gamo-Gofa zone in the Southern Nations, Nationalities and Peoples Region in Ethiopia. This two-round household panel survey database includes detailed micro-economic information on a wide variety of topics, including household demographics, land rights, agricultural production, technology adoption, livestock production, off-farm and non-farm businesses, household income, living standards, food and energy security, risk and uncertainty – as well as plot-level information and GPS coordinates of all agricultural plots of the surveyed households. The PhD candidate will implement an additional round of the survey among the same 900 selected households, using a fine-tuned questionnaire with additional and updated modules, and will combine this with the implementation of choice experiments on land- and migration-based livelihoods. The PhD candidate will exploit the rich household panel survey data

using econometric methods to investigate the above-mentioned research topics, published scientific articles on these themes and conclude a PhD at the University of Leuven in Belgium.

Concretely, the PhD research includes 1) the design and implementation of a follow-up round of a comprehensive household survey with a team of locally hired enumerators and using computer-assisted-personal-interview techniques; 2) the design and implementation of one or two choice experiments; 3) the management of a large survey database; 4) statistical and econometric analysis of survey and choice experimental data and interpretation of quantitative research results; 5) review of scientific literature on the research topics; 6) editing of research papers and a PhD manuscript; 7) presentations at seminars, workshops and international conferences; 8) dissemination of research findings at various levels in Ethiopia; and 8) management and implementation of a PhD program, including thematic and skills training courses. To execute the research, the PhD candidate needs to travel to conduct fieldwork in rural districts in the Gamo-Gofa zone in Ethiopia and to follow a PhD program at the University of Leuven in Belgium in a sandwich system (spending about half of the time of the four years of PhD trajectory in Belgium).

Profile of the candidate: The PhD candidate working on this research topic should have a solid background in economic or applied agricultural economic sciences, and a genuine interest in rural development and poverty alleviation. The PhD candidate should be fluent in English in written as well as oral communication. The PhD candidate should possess quantitative research skills, including experience with econometric data analysis and statistical software packages. Experience with household survey data collection and analysis would be an advantage. Experience with GIS software would be an advantage. The PhD candidate should be able to function well in a team and possess (starting) leadership skills.

Topic 2: **Migration and livelihoods: reshaping families, family matters, kinship and human security among the Gamo of Southern Ethiopia.**

Background: Social anthropology, introduced in 1951, is one of the youngest disciplines in Ethiopia. Despite this, the discipline has produced, especially since the 1980s, a significantly large number of social anthropology graduates – particularly at bachelor level – from Addis Ababa University as well as, since the 2000s, from universities in the regional towns such as Arba Minch. The need to address the growing demand for social anthropology graduates in governmental and non-governmental organizations seems to be fairly addressed due to the opening of social anthropology programs at Master level in various parts of the country in the last two decades. However, the demand for professionally trained anthropologists holding a PhD degree in social anthropology is yet to be addressed. Therefore, the second phase of the IUC PhD program in social anthropology has as its objective to address the growing demand for social anthropology professionals in Higher learning institutions in Ethiopia in general, and at Arba Minch University more specifically.

Theme: During the first phase of the IUC with Arba Minch University, a PhD research has been carried out on social stratification and precarity in Gamo-Gofa region, more specifically among the Gamo people.

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One of the elements that came out of this research, was that, as a response to situations of structural precarity, many young men and women – hide and leather workers, weavers, potters and other craftsmen, -women and children – leave the highlands and migrate to urban centres and towns, where their crafts and labour are allegedly more valued and rewarded than in their regions of origin. Migration often is a strategy in dealing with precarity and social exclusion, and the Gamo are known to be one of the largest migratory groups in many of the Ethiopian cities, where 'Gamo villages' are commonplace today.

This PhD project will scrutinize migration as a possible livelihood strategy by focusing on various aspects in relation to migration: (1) the history of the migration flows under study (including personal migration biographies); (2) gender and inter-generational features of migration, with a special focus on female and child migration; (3) new ideas of citizenship, belonging and home; (4) the mobility of crafts and craftsmanship; (5) human and livelihood security.

The project will have a particular focus on the entanglement of rural-urban mobility and new modalities of kinship and relatedness shaped in and across the locales of departure and destination, and how these generate newly defined relations of interdependencies, transactions, care, reciprocity in the ambivalence of social distance and proximity.

Profile: the PhD candidate working on this research topic:

- Has a Master degree in Social and Cultural Anthropology (with academic distinction)
- Has substantial experience with ethnographic fieldwork
- Has the ability to work both independently and in team
- Is fluent in English in written as well as oral academic communication
- Has the motivation to pursue creative and academic work in anthropology
- Has the ability to present research results and publish them in peer-reviewed journals.

To execute the research, the PhD candidate needs to follow a PhD program at the University of Leuven in Belgium in a sandwich system (spending half of the time in Belgium and half in Ethiopia) and s/he needs to carry out field work in rural Gamo-Gofa and in urban towns with Gamo villages.

Subproject 3

Project Background

These PhD positions frame in the context of the project entitled 'Improving Maternal and Child Health in the South Ethiopia Rift Valley – Phase 2' funded by the Flemish Interuniversity Council (VLIR UOS) as part of the 2022-2027 Inter-University Cooperation program with Arba Minch University and several Flemish Universities (Belgium). This project aims at enhancing the academic capacity of Arba Minch University-College of Medicine and Health Sciences staff in conducting academic activities (research, education and service delivery) up to international standards to improve maternal, under five and school age children's health through contextual adapted improved nutrition, service utilization, and prevention and control of diseases.

In a first phase of the project (2017-21), effectiveness a nutrient supplementation and malaria prevention and control programs on anaemia, iron status and cognitive status of school children were evaluated; innovative video-based health interventions during pregnancy, delivery (at the maternity waiting homes) and postpartum up to six months were implemented to improve the birth outcomes, postnatal care and maternal health service utilization; and epidemiologic distribution, knowledge and practice of Cutaneous Leishmaniasis (CL) treatment and the psycho social effect of CL were evaluated. In the second phase of the project, the focus of the project is described under the PhD positions listed below.

General Profile of applicants:

- You obtained your master's degree with **upper second classification**;
- You have relevant **experience** in the research topic that you apply for (specify in application letter);
- You are highly **motivated** to undertake academic research in an international context;
- You are **hard-working** and able to manage a project independently, taking initiatives and meeting deadlines;
- You develop a detailed **concept note** (pre-proposal) and demonstrate that you have the ability to finish it and produce a fully researchable and competitive proposal;
- You are ready to bring creativity, uncovering hidden issues that will benefit the project, science and local livelihood in general;
- You are frank and willing to respect agreements; you believe in project confidentiality and proper data handling and processing;
- You are willing to contribute to the administrative management of the project;
- You demonstrate **leadership** and are willing to supervise MSc students thesis projects;
- You demonstrate good interpersonal skills to interact with other project partners and stakeholders;
- You are staff member of Arba Minch University and you are willing to sign a job contracts with Arba Minch University as staff member during and beyond the PhD research project.
- **Female** candidates are strongly encouraged to apply.

PhD POSITION 1 – Multi-pronged interventions to improve maternal and reproductive health in the South Ethiopian rift valley and assessment of social determinants of health

PhD Topic

There are inequities in maternal health status within and between the regional states of Ethiopia. These inequities are usually due to diverse socio-cultural and economic differences and are revealed in terms of the uptake of reproductive and maternal health services, particularly antenatal care (ANC), skilled birth attendance, and postnatal care (PNC), which are the proxy indicators for monitoring the progress of maternal outcomes, including maternal mortality. Poor, illiterate, and rural women are less likely to use the existing healthcare services and the inequality is exacerbated by the COVID-19 pandemic. Disparities in the use of these services have also been linked to supply-side limitations (access, quality, and affordability of services) as well as demand-side limitations (mainly operating at the individual and community levels) according to prior studies in the area. The focus of this PhD will therefore be on determining the current extent of health inequalities, defining their determinants and developing intervention using a multipronged approach to achieve the 2030 Agenda for Sustainable Development of universal maternal health coverage in the South Ethiopian Rift Valley.

Specific Researcher profile:

The candidates must hold a master's degree, preferably in Reproductive Health or Maternity Nursing or Health Services Management or Epidemiology or other related disciplines, and have practical skills in statistical packages and epidemiologic knowledge. A candidate whose MSc thesis and/or has prior research experience in the field of maternal health would have an advantage.

PhD POSITION 2 – Improving micro-nutrient gap in diet to improve the nutritional status of teenage girls in South Ethiopian rift valley

Adolescence is the second period of rapid growth after the period of childhood, and a window of opportunity for compensating for early childhood growth failure. Diets of teenagers in low and middle-income countries are generally of poor quality despite the importance of this period of life, especially in girls. Different nutrition specific interventions were proposed to improve the micronutrient status of the population. Community trials to test the effectiveness of micronutrient supplementation were conducted in the first phase of IUC to improve iron and vitamin A status of school children. In the current PhD, we aim to improve the gap in micronutrient content of diet which will help to address the major micronutrient deficiency of teenage girls through the application of sustainable and innovative technologies as they have been recognized as a key group requiring nutritional support to halt the intergenerational sequelae of micronutrient deficiencies. The work under this PhD should complement an already initiated nutrition intervention trial (fortification of staple food with selected micronutrients) among the teenage population group that will be implemented in the second phase of IUC.

Specific Researcher profile:

The candidates must hold a master's degree (MSc/MPH), preferably in Human Nutrition or General Public Health or other related disciplines and have practical skills in health and nutrition researches. A candidate who has prior research experience in the field of nutrition and diet or any other nutrition specific interventions would have an advantage.

PhD POSITION 3 – Maximizing the gains from proven malaria prevention measures and breaking transmission of malaria from index case to accelerate elimination of malaria in the South rift valley

Despite there is poor access and use of bed nets, the prevalence of malaria is low in the study area as revealed from results of phase one study. If access, durability of bed net and its utilization are improved; and transmission of malaria from index cases is interrupted through integrated use of mass drug administration to individuals in the neighbours and Indoor residual spray in neighbouring houses, the incidence of malaria might be reduced drastically. Thus, in this PhD the impact of mass drug administration to neighbours of index malaria cases and Indoor residual spray on the incidence of malaria will be evaluated by using cluster randomized controlled trial to which process evaluation will be embedded.

Specific Researcher profile:

The candidate holds a MSc/MPH or specialty with medical background: MPH in public health, MPH in epidemiology and biostatistics, MSc in Tropical and Infectious Diseases, MSc in Medical microbiology, MSc in Medical Parasitology and other related health Sciences. MSc or MPH thesis and previous research experience in the area of malaria is an added value.

PhD POSITION 4 – Improving the clinical management of cutaneous leishmaniasis in the south Ethiopian: A Randomized Controlled Trail and assess socio-economic impacts among the communities of CL endemic areas of south Ethiopian rift valley.

Researches show that cutaneous leishmaniasis, a neglected tropical disease has an increasing epidemiological, psychosocial and economic impacts upon people in Endemic areas. Villages are highly affected by this disfiguring, old but strange disease of poverty. The contribution of environmental and climate changes has not been studied and the economic impacts of CL is not well documented for Ethiopia. Lack of an option for treating CL due to *L. aethiopica* and

access to modern medicine is still limited with no nationally recognized drug for treatment with Clinical Trial generated evidence. These problems will be addressed in the study by doing quantitative, qualitative and RCT.

Specific Researcher profile:

The candidate holds a MSc/MPH in health sciences and related disciplines or specialties with a medical background. A candidate whose MSc or MPH thesis and previous research experience in the area of neglected tropical diseases is an added value.

Subproject 4

Project Background

These PhD positions frame in the context of the project entitled 'Reducing land degradation through and for sustainable rural land use in the South Ethiopia Rift Valley – Phase 2' funded by the Flemish Interuniversity Council (VLIR UOS) as part of the 2022-2027 Inter-University Cooperation program with Arba Minch University and several Flemish Universities (Belgium). This project aims at increasing capacities within Arba Minch University to address land degradation processes, including sediment production by gullies and water and sediment delivery to the lakes. The general objective of this project is to **improve land use and land management practices to support sustainable rural livelihoods and the environment in the South Ethiopian Rift Valley.** In a first phase of the project (2017-21), an in-depth understanding of the land degradation processes and their controlling factors have been gained; the second phase of the project will focus on identifying, assessing and disseminating effective land use and land management practices able to reduce land degradation in a sustainable manner at different spatial scales.

General Profile of applicants:

- You obtained your master degree with **upper second classification**;
- You have relevant **experience** in the research topic that you apply for (specify in application letter);
- You are highly **motivated** to undertake academic research in an international context;
- You are **hard-working** and able to manage a project independently, taking initiatives and meeting deadlines;
- You develop a detailed **concept note** (pre-proposal) and demonstrate that you have the ability to finish it and produce a fully researchable and competitive proposal;
- You are ready to bring creativity, uncovering hidden issues that will benefit the project, science and local livelihood in general;
- You are frank and willing to respect agreements; you believe in project confidentiality and proper data handling and processing;
- You are willing to contribute to the administrative management of the project;
- You demonstrate **leadership** and are willing to supervise MSc students thesis projects;
- You demonstrate good interpersonal skills to interact with other project partners and stakeholders;
- You are staff member of Arba Minch University and you are willing to sign a job contracts with Arba Minch University as staff member during and beyond the PhD research project.
- **Female** candidates are strongly encouraged to apply.

PhD POSITION 1 – Soil and water conservation measures to reduce land degradation at sub-catchment scale

PhD Topic

At the scale of hillslopes or first order catchment, gullies and sheet/rill erosion have been identified as major processes contributing to sediment production and soil degradation. Although the occurrence of gullying is largely controlled by geological and topographic factors, suitable land use and soil and water conservation measures implemented on slopes or in gully-affected areas can help to limit incision and stabilize gullies based on a good understanding on the gully formation processes. In this PhD research, the role of soil moisture in controlling gully evolution and the efficiency of a range of physical and biological soil conservation measures for reducing sediment yield will be tested through field experiments, with a focus on the sub-catchment scale. Measures adapted to the local geomorphological context and farming practices will be selected or designed in collaboration with local farmers.

Researcher profile

The candidate holds a MSc or MA degree in Soil science, Soil and Water Conservation Engineering, Watershed Management, Water Resources Management, Hydrology, Geography and Environmental studies, Soil and Water management, Natural Resources Management or a related discipline. An MSc thesis and or previous research experience in the area of soil and water conservation measures or land degradation reductions is an added value.

PhD POSITION 2 – Modelling sediment and water budget in the current and future climate for Lakes Abaya and Chamo

PhD Topic

Sediment produced along the steep hillslopes of the rift escarpment are transported by seasonal rivers towards the rift valley. These sediments are accumulated in the lowland alluvial fans and then to the Abaya and Chamo lakes. An increase in sediment delivery and significant changes in water levels of these lakes have been noticed in the last decades. Building upon the monitoring of the river and sediment discharge of several rivers feeding to Lake Abaya and Chamo since 2018, this PhD research will aim at modeling the sediment and water discharge of different river catchments, and their contribution to the evolution of the Abaya and Chamo lakes. This will be studied for both the current and future climate change scenario's and interactions between both lakes will be taken into account.

Researcher profile

The candidate holds a MSc or MA degree in Hydrology, Water resources and Hydraulics engineering, Water resources and Irrigation Engineering, Water Resources Engineering, Watershed management, Water resources management, Soil and water conservation engineering, Soil and Water management or a related discipline. An MSc thesis and or previous research experience in the area of sediment budget estimation/modelling in related to weather/climate change or a research experience in related area is an added value.

Subproject 5

PhD POSITION 1: Feed preservation and ration formulation interventions for milk yield performance: an Ethiopian case study

Supervisors: Professor Dr Ir Geert PJ Janssens (UGent), Professor Dr Ir veerle fievez (UGent),

Professor Dr Yisehak Kechero (Arba Minch University)

Introduction

Livestock rearing has been a major source of revenue in the southern Ethiopian rift valley. Traditional ecological understanding of these sensitive tropical settings has influenced the current livestock management method. The cattle population grows in lockstep with the population density. Grazing pastures are becoming increasingly rare as more lands are cultivated for food crops to feed the rising human population. Zero-grazing is one method for both preventing overstocking and surviving with a limited number of cattle. The utilization of conserved feed staff and proper ration formulation has a lot of potential in terms of closing the dairy nutrition gap and lowering seasonal variations in milk supply and quality. The goal of zero-grazing is to retain a small number of healthy animals in stables or tied up, such as exotic cows or crossbreeds. The goal of zero-grazing is to retain a small number of healthy large cattle in stables or tied up, such as exotic cows or crossbreeds.

Materials and Methods

The goal of this study is, therefore, to see how different conservation feed staffs and ration formulation interventions affect dairy farm performance in different regions of the southern Ethiopian Rift Valley. A total of 180 small-scale dairy farms will be chosen as participants and divided into six groups of thirty: two groups focused on silage production, two groups on ration formulation, and two control groups with comparable production methods and geographic locations as the other groups. Data will be collected on daily dry matter nutrient intake, body condition score, milk production and quality, and blood parameters. While nutritional and microbial profiles of milk will be determined by laboratory examination. Using a randomized cross-over design, analysis of variance approaches will be used for various nutritional and microbiological data. The link between independent and dependent variables will also be assessed using the multilinear regression model.

Data analysis

A combination of statistical methods, such as principal component analysis, correlation, regression, mixed model analysis, and variance analysis, will be used depending on the nature of the data structure and treatments.

Valorization

Under this theme, one AMU-IUC sandwich PhD and two local Master's degree researches might be funded. Various stakeholders will be taught on enhanced feeding and dairy performance as this is an on-farm and study action research project. Finally, using a banana/maize stover or *Ensete ventricosum/*

maize silage, as well as feed rationing and advising services, Multi-nutrient block scaling up for dairy ratios, boosted milk output and minimized seasonal milk fluctuations.

PHD POSITION 2: Optimization of strategies to soil fertility management and plant material development of Enset to reduce the impacts of bacterial wilt

Potential supervisor: Professor Dr. Ir. Geert haesaert (UGent), Professor Dr. Ir. Olivier Honnay (KuLeuven), Karen Vancampenhout (KuLeuven), Roel Merckx (kuLeuven.be),

Introduction

The resilient enset farming system is suffering from Enset Xanthomonas wilt (EXW) and declining soil fertility. Enset is cultivated in the fertile homesteads based only on manure and household refuse with rates not precisely quantified. On the other hand, expansion of enset to the outfields, where mainly mineral sources are applied is limited by lack of adequate organic resources as a result of land fragmentation and diminishing livestock base. This resulted in sub-optimal soil nutrient status in enset and at farm scale with consequences on reduced entire farm productivity. As a result, over-fertilization was evident in enset farms with nutrient levels declining with distance from the house (Shara et al., 2021). Moreover, over-fertilization is decreasing plant defense mechanisms by suppressing arbuscular mycorrhizal fungi diversity (AMF) (Garo et al., in press). AMF are known to increase plant defense mechanisms and phosphorous uptake. Preliminary on-farm studies informed that agro-ecology and management influenced EXW susceptibility (Mathilde et al., 2018; Ieben et al., 2018). Field experiments also showed that agro-ecology and plant nutrition influenced enset early growth (unpublished own data). On-farm studies also indicated that soil nutrient levels (e.g. P, K, Ca, and Mg) are linked to infection by EXW, whereby higher soil levels of P and K and lower tissue levels of Ca, Mg, and Cu, Zn were observed suggesting EXW susceptibility would link imbalances in K-Ca-Mg (Shara et al., 2021). In a field trial, P fertilization has shown to temporarily reduce wilt incidence (unpublished own data). Plant nutrition can reduce susceptibility to disease up to the optimum levels for growth, but the effect depends on type of nutrient, nature of pathogen, host species and other environments, yet optimum nutrient recommendations are not available for enset. Therefore, this study aims to (i) Examine soil nutrient balances in higher, middle and lower enset landscapes, (ii) estimate the optimum combined

application rates of N-P-K from mineral and organic sources to improve traditional soil fertility management in enset farming system in the more optimum middle altitude, and (iii) assess effect of integrating, boi-inoculant, mineral and organic nutrient sources on enset plant material growth, dry matter yield and EXW susceptibility, iv) investigate effects of AMF inoculation on enset Xanthomonas wilt development.

Materials and methods

This study will be carried out in the Bonke and Chencha-catchments of the Gamo highlands due to the presence of wide range of altitudes and related on-farm and experimental studies conducted in the research stations in the catchment. EXW prevalence and nutrient balances will be assessed in farmers' fields at three different agro-ecologies using on-farm surveys and through monitoring of nutrient inputs and outputs. For nutrient optimization studies, two local enset varieties and four nutrient treatments will be established using farmers' plots as replications in the more optimum middle altitude. Clean planting materials (micro or macro propagated) will be planted and growth and dry matter yield will be monitored for two years. Then, the plants will be artificially inoculated with AMF and Xanthomonas and disease progression will be monitored.

Data analysis

Based on the nature of data structure and treatments, combination of different methods such principal component analysis, correlation, mixed model analysis and analysis of variance will be employed.

Conclusion and suggestion

Status of nutrient (K-Ca-Mg) balance in established enset farms and optimum N-P-K rates will be determined for enset. Better understanding on the interaction of nutrients with plant material growth and EXW susceptibility will be achieved. The determined optimum rates would be formulated and tested at different enset ecologies.

Subproject 6

Topic 1. Application of Remote Sensing in Aquatic Ecology: Lake dynamics in response to human impact and restoration.

Lake Chamo and Lake Abaya are strongly threatened by human impact linked to massive land degradation and erosion, encroachment of the shoreline and overexploitation. While Lake Chamo is still in a much better ecological state than Lake Abaya, its water quality is steadily deteriorating, and it is not only threatened by catchment and shoreline activities but also by overflow dynamics of Lake Abaya. In this PhD, we will combine aquatic ecological approaches with satellite- and drone-based remote sensing to study the dynamics of water quality, the development of littoral vegetation and the spread of an invasive plant species (*Eichornia crassipes*) in response to variation in weather conditions and human impact, and monitor responses to large-scale vegetation restoration in the catchment and along the littoral zone of the lake itself.

Indicative, the following chapters will be developed:

Chapter 1: Combining water quality monitoring using in-situ sampling with regular assessments by drone to document the short-term dynamics in water quality (turbidity, sediment load, algal blooms) in relation to extreme weather events (e.g. heavy rainfall).

Chapter 2: Linking ground-truthing data with drone assessment of water quality to satellite images in order to allow reconstruction of the water quality dynamics over larger geographic scale and a time span covering years to decades. In-situ monitoring, drone and satellite data can subsequently be used to monitor responses to large-scale restoration of catchment vegetation, monitoring the success of forest restoration projects.

Chapter 3: Using drone-based mapping of littoral vegetation, encroachment and restoration, ground-truthed by in-situ observations, to study (a) the impact of littoral vegetation buffer zones on water quality and (b) the impact of restoration of littoral vegetation on the development of emergent and submerged vegetation and water quality.

Chapter 4: Using drone-based mapping combined with in-situ observations to develop a method to quantify the spread of invasive floating vegetation, currently rapidly increasing in Lake Abaya but still only marginally present in Lake Chamo. Drone mapping will be linked to satellite data in an effort to reconstruct the dynamics over longer time spans.

As an important basic information for all these chapters and future research, the project will develop remote sensing based digital bathymetry for Lakes Abaya and Chamo.

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Potential links with other sub-projects: P4, PhD's 2 and 3; with P5 Agroforestry

Topic 2. Ecosystem Services Provisioning by Agroforestry Practices in the Lowlands of the South Ethiopian Rift Valley

Potential supervisors Flanders: Olivier Honnay, Karen Vancampenhout, Bart Muys

Potential supervisors Arba Minch: Simon Shibru

Agroforestry is defined as the integration of trees and woody shrubs in crop and livestock production systems. It exist under many different forms, including the intercropping of trees within annual crops, trees intercropped with plantation crops and cultivation of trees in home gardens. It is widely promoted because it can provide a multitude of ecosystem services (ESS) such as carbon sequestration, improvement of soil fertility and microclimate, erosion prevention, and conservation of biodiversity on agricultural lands, while at the same time generating economic benefits for farmers through increasing yields and providing non-crop products such as timber, fodder, firewood and fruits. Overall, agroforestry has the potential to contribute to a number of the SDGs simultaneously, although there might be trade-offs too, for example with yields. The benefits of agroforestry in sub-Sahara Africa are not very well studied, and there is a need for additional well-replicated observational and experimental studies.

The general aim of this PhD research within project 6, and that aims to create synergies with Project 5, will be to assess the various ESS that are provided by agroforestry systems in the lowlands North of the town of Arba Minch.

The specific aims are the following:

1) Provide an in-depth overview of the different types of agroforestry systems and the ESS that they deliver through field surveys and structured interviews with farmers.
2) Evaluate the benefits of agroforestry for one or two selected dominant agroforestry systems in the study region, in terms of crop yields and yield stability, soil fertility and microclimate, based on observational research.
3) Evaluate the benefits of agroforestry for one or two selected dominant agroforestry systems in the study region in terms of the ESS pollination and predation of pests, based on observational research.
4) Set up an intervention study to evaluate the effects of agroforestry on the provisioning of a set of ESS to be defined later, likely related to water run-off and erosion resistance.

Candidates should have a keen interest in agronomic ecology, be prepared to do field work during longer time periods, and they should already have a basic knowledge of statistical data analysis.

References

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