

Research Application Summary

**African Center of Excellence for Climate Smart Agriculture and Biodiversity
Conservation at Haramaya University (ClimateSABC)**

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Abstract

Climate change is a global issue posing challenges to sustainable agriculture, biodiversity and development. The impacts of climate change are pronounced in Eastern and Southern African countries more than any other regions of the continent. Climate change poses a serious risk to agriculture, natural resources, biodiversity and subsequently poverty reduction efforts in the region. The problems associated with climate change: food-insecurity, malnutrition, poverty and biodiversity loss are interwoven and remain as primary development challenge to Eastern and Southern African countries. Agriculture, the pillar of the economies of the region has been practiced for millennia largely without modern science and technology. The agricultural productivity of the region is lower than in other African regions. Addressing these challenges requires sustained investment in human capital to generate new technologies and innovations. Yet the current human and institutional capacity of the region generally falls short of meeting these challenges. There is also a growing recognition that new approaches and technologies are needed, with new alliances and partnerships and a renewed vision for building regional strengths to combat these challenges more effectively. The African Center of Excellence for Climate Smart Agriculture and Biodiversity Conservation (ClimateSABC) at Haramaya University in Ethiopia was proposed in response to the World Bank's African Centres of Excellence (ACE II) initiative. The objective of ClimateSABC is to produce skilled human capital through research-based quality post-graduate programs and short-term, skill-based training courses. We plan to upgrade our teaching and research facilities, support development and implementation of appropriate curricula and research programs through an integrated and holistic approach with our partners from other universities in the Eastern and Southern African region and other parts of the world. At the Centre, Master's and PhD level training will be provided and applied research will be conducted focusing on generating climate smart agricultural technologies, intensifying agriculture, promoting and enhancing practices of climate smart agriculture, and exploring sustainable conservation and utilization of biodiversity. A doctoral (PhD) program to be offered under the auspices of the Climate Smart Agriculture and Biodiversity Conservation will have four sub-specializations (Crop Sciences, Livestock Sciences, Soil and Water Science, and Policy, Institution and Innovation Studies). Five MSc programs will be offered, with two new ones (Climate Smart

Agriculture, and Biodiversity and Ecosystem Management) and three existing regional ones (Agrometeorology and Natural Risk Management, Agricultural Information and Communication Management, and Collaborative Master's Program in Agricultural and Applied Economics). In addition, short term training programs will be conducted targeting various stakeholders and partners, including technical staff, students, and faculties from regional, international, and national partners aimed at enhancing their knowledge and skills in climate smart agriculture and biodiversity conservation. Regional, international, and national research partnerships will also be established and joint research conducted and publications produced in priority areas in the region. In summary, the project is aimed at producing skilled human capital to tackle challenges posed by climate change through quality post-graduate education and research at Haramaya University in partnership with universities across the Eastern and Southern African Region as well as with other institutions of higher education in the World.

Key words: Climate change, Ethiopia, quality graduate training and research, skilled human capital

Résumé

Le changement climatique est un problème mondial qui pose des défis à l'agriculture durable, la biodiversité et le développement. Les impacts du changement climatique sont prononcés dans les pays d'Afrique de l'Est et du Sud plus que les autres régions du continent. Le changement climatique pose un risque sérieux pour l'agriculture, les ressources naturelles, la biodiversité, et par la suite les efforts de réduction de la pauvreté dans la région. Les problèmes liés au changement climatique tels que l'insécurité alimentaire, la malnutrition, la pauvreté et la perte de biodiversité sont entremêlés et restent un défi primaire de développement des pays africains du l'Est et du Sud. L'agriculture, un pilier de l'économie de la région a été pratiquée depuis des millénaires en grande partie sans la science ni la technologie moderne d'où la productivité agricole de la région est plus faible que dans d'autres régions d'Afrique. Relever ces défis nécessite un investissement soutenu dans le capital humain pour générer de nouvelles technologies et innovations. Pourtant, la capacité humaine et institutionnelle actuelle de la région est généralement insuffisante pour relever ces défis. Il y a aussi une reconnaissance croissante que de nouvelles approches et technologies sont nécessaires, avec de nouvelles alliances et de partenariats et une vision renouvelée, pour la construction de forces régionales capables de lutter contre ces défis de manière plus efficace. Le Centre africain d'excellence pour l'Agriculture intelligente face au changement du climat et conservation de la biodiversité (ClimateSABC) à l'Université de Haramaya en Ethiopie a été proposé en réponse de l'Initiative de la Banque mondiale pour créer des centres africains d'excellence (ACE II). L'objectif de ClimateSABC est de produire un capital humain qualifié grâce à des programmes axés sur la recherche de qualité de troisième cycle et à court terme, et des cours de formation axés sur les compétences. Nous prévoyons de mettre à niveau nos enseignements et de recherche, soutenir le développement et la mise en œuvre des programmes appropriés d'enseignement et de recherche grâce à une approche intégrée et holistique avec nos partenaires des autres universités de l'Est et de la région de l'Afrique australe ainsi que d'autres parties du monde. Au centre, la formation de niveau Doctorat et

Maîtrise et sera dispensée et la recherche appliquée sera réalisée en mettant l'accent sur la génération de technologies agricoles intelligentes par rapport au climat, l'intensification de l'agriculture, la promotion et l'amélioration des pratiques de l'agriculture intelligente par rapport au climat, et d'explorer la conservation et l'utilisation durable de la biodiversité. Il est prévu qu'un programme de Doctorat qui sera offert sous les auspices de l'Agriculture Intelligente climatique et la conservation de la biodiversité aura quatre sous-spécialisations (les sciences végétales, les sciences Animales, les sciences du sol et de l'eau, et les études de la politique, les institutions et les innovations). Cinq programmes de maîtrise seront offerts, avec deux nouveaux (Agriculture intelligente climatique et biodiversité et la gestion des écosystèmes) et trois les régionaux déjà existants (agrométéorologie et la gestion des risques naturels, la gestion de la communication de l'information agricole, et le programme collaboratif de maîtrise en économie agricole et appliquée). En outre, des programmes de formation à court terme seront menés ciblant différents acteurs et partenaires, y compris le personnel technique, les étudiants et les facultés des partenaires régionaux, internationaux et nationaux visant à améliorer leurs connaissances et leurs compétences dans l'agriculture intelligente du climat et de la conservation de la biodiversité. Les partenariats régionaux, internationaux et nationaux de recherche seront également mis en place et des recherches conjointes menées et des publications produites dans les domaines prioritaires de la région. En résumé, le projet vise à produire un capital humain qualifié pour relever les défis posés par le changement climatique par le biais de l'éducation de qualité post-universitaire et de la recherche à l'Université de Haramaya en partenariat avec les universités de la région de l'Afrique orientale et australe, ainsi qu'avec d'autres établissements d'enseignement supérieur dans le monde.

Mots clés: changement climatique, l'Ethiopie, la formation des diplômés de qualité et de la recherche, le capital humain qualifié

Background: Development challenges

Climate change is a worldwide problem posing challenges to the survival of mankind and sustainable development. It is already imposing a significant challenge to Eastern and Southern African countries by causing natural resources and biodiversity degradation and subsequently affecting food security, water and energy supply, poverty reduction and sustainable development. These countries have contributed the least to the problem, but are highly susceptible to the impacts of climate change. They are also the least prepared to cope up with climate change and the associated problems, since the adaptive capacity of their socio-economic systems is lower compared to in other African regions (Umesh *et al.*, 2015).

Agriculture in sub-Saharan Africa (SSA) is predominantly practiced by smallholder farmers, who represent some 33 million households, 80% of the farms, each with less than 2 ha, and generate 90% of the continent's food supply (FAO, 2013; AGRA, 2014). Agricultural productivity in SSA is lower than in other developing regions and far below its own potential (Rosen and Shapouri, 2012). African agriculture is mostly rain-fed, with very limited (<5%) irrigation in much of the continent. Climate change poses the greatest threat to food security in Africa. It is already contributing to cycle of poverty and recurrence of food shortages in

the continent, including in places such as Ethiopia. The continent is expected to get hotter in the foreseeable future, where the combination of increasing temperature and changing rainfall patterns could make annual production of food crops and livestock on an increasingly eroded land and scarce water resource base even more risky and largely unpredictable (FAO, 2006). Burdened with growing weather variability, smallholder farm households are under further threat of becoming the most food-insecure, undernourished, and poverty-stricken sector of the African society (AGRA, 2014).

Climate change has been also causing extinction of species and reduction in biodiversity (Rudolfo and Raven, 2003). Global average surface temperature increase of 2°C could commit about 15-40% of species to extinction (Stern, 2006). The loss of agro-biodiversity has inevitable risks and costs to agricultural productivity and food security (Thrupp, 2000). By 2085, Africa is expected to lose between 25 and 42% of the species' habitats (McClean, 2005). The Eastern and Southern Africa countries have highly variable climates that make these regions highly sensitive to small changes in the global climate, and which invariably causes biodiversity loss. Loss of biodiversity limits coping and adaptation options in the face of climate change.

There is clear evidence that the conventional agricultural production system of eastern and southern African regions failed to cope up with the impact of climate change on livelihoods, food security and biodiversity which is further aggravated by anthropogenic factors (FAO, 2013). *Climate smart agriculture (CSA) is an approach to develop the technical, policy and investment conditions to achieve sustainable agricultural development for food security under climate change and variability.* This approach can strengthen livelihoods and food security, especially of smallholders, by improving the management and use of natural resources and adopting appropriate methods and technologies for the production, processing and marketing of agricultural goods. CSA supports countries in putting in place the necessary policy, technical and financial means to mainstream climate change considerations into agricultural sectors and provide a basis for operationalizing sustainable agricultural development under changing conditions (FAO, 2013).

With increased awareness, rural communities in the eastern and southern Africa sub-region are opening up to scientific interventions, demanding improvements in both crop and livestock management practices, including new crop varieties, supply of agricultural inputs, new technologies to increase production, reduce pre-and-post-harvest losses, and new value-added products that lead to higher incomes. However, the region faces a shortage of highly skilled professionals with specialized knowledge who can innovate and boost productivity in these areas. Therefore, it is necessary to develop new specialized training program or re-orient curriculum to integrate climate change scenarios, adaptation and mitigation strategies.

The higher education sector in Eastern and Southern African (ESA) faces severe constraints in terms of producing a critical mass of graduates to meet regional development needs. Despite recent rapid expansion in higher education enrollment in the region, comparatively, ESA countries have a long way to go and compare unfavorably with other regions. Female enrollment rates are particularly low, averaging 1 percent in Malawi and Ethiopia, well

below the world average of 7 percent. Overall, the ESA region produces low numbers of graduates in science, health, agriculture and engineering with less than 30 percent of graduates majoring in these fields (World Bank, 2014). The region suffers not only from inadequate number of graduates, but also low quality and relevance of their education and training. Very few staff members have PhDs. It is estimated that only about 100 PhDs are produced annually by higher education institutions across 31 countries in SSA in science, technology and engineering. Worse still, the institutions lack the resources to attract top quality staff, nor are they able to provide staff support with research facilities (World Bank, 2014).

Most of the research outputs in countries in Eastern and Southern Africa are produced with international (non-African) collaborations. For example, only 30 percent of publications in Eastern Africa and 20 percent in Southern Africa are the result of national and/or regional collaborations. This shows that most of the research agenda is often set by the international partner (s) rather than originating from and being oriented to alleviating local development challenges (World Bank, 2014).

Agricultural graduates from higher education institutions in eastern and southern African countries are not only limited in number but also ill-equipped with knowledge and skills required to effectively address development challenges. Thus, we see in the ACE initiative an opportunity to combine graduate education with an enhanced research capability for strengthening the research capacity of agricultural institutions in the Eastern and Southern Africa region.

Investment in post-graduate education generates highly skilled human power for serving academic and research institutions as well as the civil service and policy making institutions. Enhanced human capital is central to the development of much-needed, locally relevant scientific knowledge and technology to tackle major development challenges in African agriculture (Cross *et al.*, 2014).

It was hypothesised to establish an 'African Center of Excellence for Climate Smart Agriculture and Biodiversity Conservation' at Haramaya University, Ethiopia. We believe that 'climate smart agriculture' offers a great potential to increase sustainable productivity and resilient farming systems to climate effects, and mitigate impacts of climate change through greenhouse gas emission reductions and carbon sequestration (FAO, 2010). For the purposes of this new funded project proposal, we define 'climate smart agriculture' as innovative production systems that integrate crop and livestock genetic improvement with management practices that increase productivity in a changing climate, while enhancing the socio-economic and environmental sustainability of the agricultural landscape and the natural resource system ecology. It specifically embodies soil and nutrient management, water capture and use, pest and disease control, resilient ecosystem, genetic resources, integration of livestock-crop production, harvesting, processing, and supply chains (FAO, 2010).

Haramaya University is considered as the premier institution of agricultural higher education in Ethiopia. Many of the leading senior agricultural leaders and professionals hail Haramaya University as their alma mater. In spite of its national reputation, Haramaya University has

not lived up to expectations in terms of producing post-graduates that have impacted agriculture and rural development, as its nascent postgraduate programs have faced formidable challenges in many of the following areas:

- a. Inadequate skill-based learning and poor research programs and curricula that do not support relevant knowledge gains to address relevant and practical problems.
- b. Inadequate teaching and research facilities (inadequate internet infrastructure and ICT services, poorly maintained laboratory instruments, and plant growth facilities).
- c. Unable to recruit and retain technicians with skills in operating and maintaining advanced analytical instruments essential for producing graduates with high technical skills required for quality research outputs.
- d. Unable to attract pool of regional/international students, in the absence of functional international collaboration/networking/partnership agreements for joint teaching and research.
- e. Lack of programs for enhancing entrepreneurial skills of graduates.
- f. Low female enrolment in postgraduate programs.
- g. Underdeveloped university-industry linkages.
- h. High attrition of faculty because of modest terms of employment, lack of incentives, and a growing national and regional market place with attractive compensation.
- i. Faculty and staff with limited opportunities for regional and international travel to gain new knowledge and experience.
- j. Limited exposure and experience in conducting interdisciplinary research to address more complex problems.
- k. Limited opportunity to enhance skill and capacity for scientific writing to produce research publications, write grant proposals, or prepare professional presentations.

Objectives of the ACE for ClimateSABC

The **general** objective of the 'Haramaya University Center of Excellence for Climate Smart Agriculture and Biodiversity Conservation' is to improve the quality of postgraduate education and research in eastern and southern Africa so as to foster enhanced capacity to adapt and mitigate effects of climate change and weather variability, and ensure biodiversity conservation more effectively in the region. The specific objectives are to;

- (i) Produce skilled MSc and PhD graduates in 'climate smart agriculture and biodiversity conservation' that are capable of addressing current and emerging developmental challenges.
- (ii) Generate new knowledge and quality research outputs as well as promote technological innovations to address national and regional development challenges.
- (iii) Enhance knowledge, skills and scholarship and research culture of faculty and technical personnel at universities to lead a more effective, result-oriented, and high quality post-graduate training with cutting edge research.
- (iv) Upgrade teaching and research facilities (laboratories, ICT services, greenhouses, lath houses, meteorological stations, research farms, etc.).

- (v) Strengthen national, regional, and international collaborations and partnerships to enhance exchange of science and technology skills, experience, and expertise.
- (vi) Foster specialization in specific areas of excellence and collaboration with emerging higher education institutions.
- (vii) Establish a program for continued funding to sustain high quality postgraduate training and cutting edge research in climate smart agriculture and biodiversity conservation in the region.

Strategies to tackle the development challenges

The project focuses on producing skilled human capacity through research based postgraduate programs targeting the next generation of skilled local and regional faculty. The desired outcomes is to have graduates with highly enhanced agricultural knowledge, and research skills that would address current and emerging local and regional challenges of agricultural development. To achieve the above, several activities will be undertaken;

- a. Design more relevant curricula** geared to solve regional problems and fulfil demand-driven and appropriate teaching and research needs
 - (i) New MSc and PhD curricula will be developed in Climate Smart Agriculture and Biodiversity Conservation. The new PhD curriculum in Climate Smart Agriculture and Biodiversity Conservation will have four specializations: Crops; Livestock; Soil and water; and Policy, institutions and innovations as well as biodiversity conservation.
 - (ii) The MSc programs under this project include two new programs (one in Climate Smart Agriculture; and another one in Biodiversity and Ecosystem Management) and three existing regional programs namely, Agrometeorology and Natural Risk Management; Agricultural Information and Communication Management; Collaborative Master's Program in Agricultural and Applied Economics (CMAAE) in Eastern, Central & Southern Africa. The new curricula will encompass experiential, hands-on learning approaches as required to complement lectures and laboratory/practical exercises
 - (iii) Existing regional MSc and PhD programs at the college of Agriculture and Environmental Sciences will be revised and aligned with climate smart agriculture, gender sensitivity, entrepreneurial orientation, and environmental stewardship
- b. Offer short courses:** A number of short courses have been designed to be offered to postgraduate students, academic and support staff as well as partner institutions. Short term courses will be offered to enhance students' skill development in critical areas. The short courses will include: Precision Ag Concepts, Geo-Spatial Thinking, Scientific communications, ICT in teaching and research, Entrepreneurial skills and career development.

- c. Invite visiting Scholars:** Seminars and lectures will be held by distinguished national, regional, and international scholars, and attended by students and staff. Visiting scholars/scientists will be supported to address staff shortage in some areas and enhance excellence in teaching and supervision.
- d. Enhance quality of graduates through upgrading teaching and research facilities:** The ACE will strengthen the internet infrastructure and the ICT services and furnish the teaching and research laboratories with instruments. It will also staff the lab and field research facilities with skilled personnel; improve the field research facilities (greenhouses and lath houses, field research stations) and instal digital meteorology stations at the research sub-stations representing different agro-ecologies.
- e. Build up skilled human capital:** The number of MSc and PhD enrolments will be significantly increased during each year of the project period by increasing the number of local faculty with PhD degrees at the University. In total the project is expected to train M.Sc. and PhD students.
- f. Offer short term training courses at regional institutions:** We will enhance skills of graduate students and faculty members to improve entrepreneurial and other soft skills through short-term courses, seminars, conferences and workshops.
- g. Enhancing competence and skills of personnel working in laboratories and other teaching and research facilities:** Laboratory technicians and mangers, field research field assistants, technical assistants, farm mangers, biometricians and statisticians will be trained at Masters and PhD levels. These trained supporting staff will help strengthen the teaching and research capacity existing at the University.
- h. Improving the information management system:** The governance, leadership, and management will be enhanced by introducing management information systems to improve the effectiveness of teaching and research.
- i. Strengthening research and technology generation and dissemination:** Efforts will be made to establish strong link between graduate education and research and having research activities focused on achieving a good mix of multi-disciplinary applied research for direct technology transfer/exchange as well as basic research for long-term innovation.
- j. Leveraging additional funding for agricultural research:** Soliciting for post-graduate research funds from national, regional, and international sources through collaborative research grant proposals that are geared towards addressing the challenges faced in attaining food and nutrition security and agricultural development in the region.
- k. Increase regional collaboration with other institutions of higher learning in other nations:** A scholarship fund is to be created to strengthen and deepen collaborations with other institutions for the development and sharing of academic resources and

capacities through innovative staff exchanges, twinning of programs, co-supervision, sandwich programs, and joint degrees.

- l. Produce more MSc and PhD graduates:** We will increase admission and working effectively with MSc and PhD students in agriculture, drawing on external regional education support programs; strengthening relationships between universities and industry; strengthening intra-regional graduate study supervisions, etc.
- m. Increase enrolment of women in MSc and PhD programs:** The project will develop a special fund to support women's scholarship and establish mentoring programs to enhance their scientific acumen, writing skills, and overall professional development and success.
- n. Foster collaborative technological innovations:** The project will establish strong agriculture research and educational network with key partners, peer institutions and regional and international collaborators, and particularly with the emerging private sector in the country and the region, to accelerate the development and deployment of technologies more effectively and widely.

Expected results

The ClimateSABC project is expected to generate a number of outputs which among others include improvement in quantity and quality of PhD and MSc graduates, skill enhancement of staff and graduates, technology generation, publications, strengthened collaborations (national, regional and International), curricula accreditations, enhancement of infrastructure, attraction of donor funding, etc within the five years of the project period. Hence some of the specific results envisaged for the project period:

- (i) Thirty (30) PhDs and 80 MSc. trained of which about 75% will be from national and 25 % from the region. Overall, at least 20% will be females.
- (ii) Twelve (12) short courses relevant to the needs of the region developed.
- (iii) Ten (10) capacity building workshops conducted.
- (iv) Trained six university top management
- (v) Thirteen (13) retooling workshops to build capacity of University teaching and technical staff
- (vi) Four (4) retooling workshops to build capacity of University administrative/finance staff.
- (vii) One hundred and ten (110) intern fellowships awarded to ACE students.

- (viii) Ten (10) collaborative joint research projects with partners implemented.
- (ix) Teaching and research facilities procured, installed and commissioned
- (x) ICT infrastructure of the ACE enhanced.
- (xi) One hundred and two (102) national and sixty six (66) regional, of which 30% females, completed short term training.
- (xii) Policy briefs related to ClimateSABC produced and disseminated.
- (xiii) At least eighty (80) publications published in peer-reviewed journals (60) and peer reviewed conference proceedings (20).
- (xiv) About 3,050,000 USD generated from external sources.
- (xv) Forty (40) academic staff, of which 10 % females, trained in a private sector company, regional or local institutions relevant to their field of studies.
- (xvi) About 20 climate smart agriculture and biodiversity technologies generated and disseminated
- (xvii) New and innovative teaching approaches and methods Institutionalized.
- (xviii) Three academic programs accredited at national, regional and international levels.

Partner Institutions (national, regional, and international)

The project will engage a number of national, regional and international partner institutions (Table 1). Partners will be involved in teaching, research, and networking; will provide internship to staff and students; provide technological backstopping; provide collaborative environment; support advocacy for ACE projects; support linkage of academia and private sectors/industries; provide national/regional/international level strategic engagement for addressing development challenges; participate in annual meetings, etc. The Center will provide training opportunities for the staff of partner institutions. Key partners will be entitled to a total of 15% of the total budget to enable them effectively support the programs.

Governance structure

At the national level, the project will be overseen by National Steering Committee members who will be drawn from the ACEs hosting Universities within the country (Addis Ababa University and Haramaya University), Ministry of Education, Ministry of Science and Technology, Ministry of Health, Ministry of Agriculture, Water and Energy, Ethiopian Railway Corporation and private higher education association.

Table 1. Lists of partner institutions

Category/type of partnership	Key Partner	Partner
Advanced knowledge institution	Purdue University	Wageningen University and Research Centre (WUR); Kansas State University; Oklahoma State University; Technical University of Denmark; Copenhagen University
Private sector national		Oromia Seed Enterprise, Oda Bultum Farmers' Cooperative Union, Elfora, Alfoz, Elemtu Integrated dairy development, Harar Brewery, Dire Dawa National Cement Factory, Hamaessa Edible Oil Share Company
Private sector international		CARE Ethiopia Sola Grow
Peer universities national	Bule Hora University, Oda Bultum University	Jigjiga University, Samara University, Maddawalabu University, Mekelle University, Jimma University, Hawasa University
Peer universities regional	Makerere University, Lilongwe Universities of Agriculture and Natural Resources, Nelson Mandela African Institution of Science and Technology	Juba University, Gezeira University, Sokoine University of Agriculture, Abomey Calavi University
Research institutions national	EIAROARI	Ethiopian Agricultural Transformation Agency, HERQA (Higher Education Relevance and Quality Assurance), IBCR (Institute of Biodiversity Conservation and Research)
Research institutions regional	Regional Universities Forum for Capacity Building in Agriculture (RUFORUM)	ASARECA (Association for Strengthening Agricultural Research in Eastern and Central Africa)
Research institutions international	Purdue University	International Centre for Agricultural Research in Dryland Areas (ICARDA), International Livestock Research Institute (ILRI), International Water Management Institute (IWMI), IFPRI, CIMMYT
Line ministries, authorities, and agencies		Ministry of Education, Ministry of Agriculture, Ministry of Water, Irrigation and Energy, Ministry of Forest and Environmental Protection, National Meteorological Agency, Regional State Research Institutes, Awash-Basin Authority

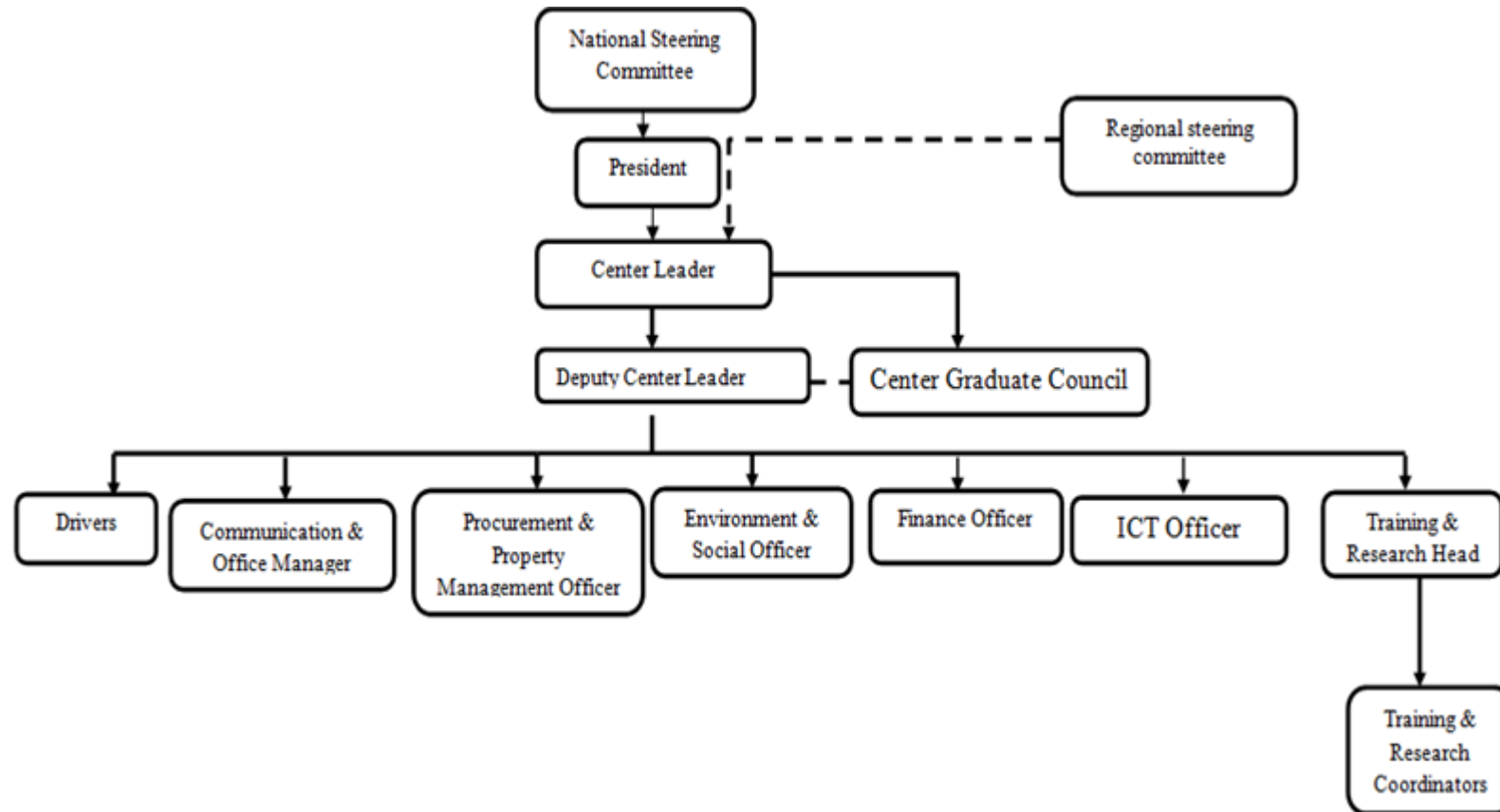


Figure 1. Organizational chart of ACE ClimateSABC

Under the current collegiate structure of Haramaya University, ClimateSABC program will operate as an independent center of excellence with functional linkage to the College of Agriculture and Environmental Sciences and other relevant academic programs of the University. The Centre will have its own leader who will provide overall leadership and guidance. The Deputy Center Leader will serve as the ACE project manager and oversees the overall functioning of the ACE.

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