U.S. Agency for International Development (USAID)
and
The American Council on Education (ACE)
office of Higher Education for Development (HED)

Michigan State University and University of Malawi Partnership
"Agro-ecosystems Services: Linking Science to Action in Malawi and the Region (AgESS)"

April 5, 2011 – May 30, 2014

FINAL ASSOCIATE AWARD REPORT
August 2014

USAID/Malawi Associate Award
Cooperative Agreement # AEG-A-00-05-00007-00
Associate Cooperative Agreement # 674-A-00-11-00030-00

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American Council on Education (ACE) | American Association of Community Colleges (AACC) | American Association of State Colleges and Universities (AASCU) | Association of American Universities (AAU) | National Association of Independent Colleges and Universities (NAICU) | Association of Public and Land-Grant Universities (APLU)

PARTNERSHIP INFORMATION

Lead Partner Institutions: Michigan State University; University of Malawi-Chancellor College; Lilongwe University of Agriculture and Natural Resources (LUANAR)
Secondary Partner Institutions: The Lincoln University
Region, Country: Malawi
Performance Period: *April 5, 2011 – May 30, 2014*
Funding Level: Associate Award: $1,385,806 and Subaward: $1,140,000
Proposed Cost Share: $322,204

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List of Acronyms

ACE	American Council on Education
AgESS	Agro-EcoSystems Services
APLU	Association of Public and Land-grant Universities
ASWA	Agriculture Sector Wide Approach
FY	Fiscal Year
GOM	Government of Malawi
HED	Higher Education for Development
HICD	USAID's Human and Institutional Capacity Development
ICRISAT	International Crop Research Institute for Semi-Arid Tropics
INVC	Integrating Nutrition in Value Chains
JOCA	Japan Overseas Cooperative Association
M&E	Monitoring and Evaluation
MGDS	Malawi Growth & Development Strategy
MOAFS	Ministry of Agriculture & Food Security
MSU	Michigan State University
NGO	Non-Governmental Organization
LU	Lincoln University
LUANAR	Lilongwe University of Agriculture and Natural Resources
PAR	Participatory Action Research
PEER	Partnerships for Enhanced Engagement in Research
PES	Payment for Ecosystems
PRIME	Partnership Results and Information Management Engine
PhD	Doctorate Degree
TANUVAS	Tamil Nadu Veterinary and Animal Sciences University
UNIMA	University of Malawi
USAID	United States Agency for International Development
USAID/AFR	United States Agency for International Development/Africa Bureau
USG	United States Government

1. Executive Summary

This report is for the Associate Award Agreement #674-A-00-11-00030-00 between USAID/Malawi and the American Council on Education, Office of Higher Education for Development (ACE/HED), for a three-year award of $1,385,000 effective April 5, 2011. The award was extended twice, first at no cost from April 4, 2013 to September 30, 2013, and second at cost through May 30, 2014 and increasing the total award amount by $285,000 to $1,385,000. The partnership between Michigan State University (MSU), and University of Malawi (UNIMA) entitled, **"***Agro-Ecosystems Services (AgESS): Linking Science to Action in Malawi and the Region***,"** sought to enhance human and institutional capacities within the area of AgESS—the benefits that ecosystems provide to people and environment.

The partnership was established to strengthen Lilongwe University of Agriculture and Natural Resources (LUANAR) and Chancellor College/UNIMA in the area of AgESS, enabling these institutions to enhance faculty development and respond to research, curricula, and outreach needs identified by government, the colleges, private sector, and non-governmental organizations (NGOs). The partnership strove to address issues related to sustainable land and water management and forestry management; soil fertility and conservation agriculture; agricultural and natural resource governance and policy dialogue; management of the agro-ecosystems dimensions of climate change; and enhanced agricultural research capacities.

The partnership was built on a long-standing relationship between MSU and UNIMA that extends back twenty-five years. This historical foundation contributed to the success of the partnership in terms of understanding the Malawian context and navigating implementation challenges. The four partner institutions, Michigan State University (MSU), Chancellor College/University of Malawi (UNIMA), Bunda College/LUANAR, and Lincoln University (LU), contributed different levels of expertise and experience to address the development strategies articulated by the Malawi Growth and Development Strategy (MGDS), Ministry of Agriculture and Food Security (MOAFS), and USAID/Malawi's Feed the Future Strategy.

Over the three years of implementation, the partnership directly benefitted 722 individuals through the following key accomplishments:

Through the design and delivery of three agro-ecosystem services (**AgESS) short courses**, partners were able to train faculty members, students, and external stakeholders in areas of AgESS by expanding their knowledge and exposing participants to new strategies and resources, making the universities better equipped to address development challenges through improved research, teaching, and outreach. Practical, hands-on technical **short courses** in grant writing, financial management, and fundraising courses improved the skills of members of LUANAR and Chancellor College faculty and staff. Faculty members and staff are now aware of new ideas and strategies for creating linkages with external stakeholders and are also better equipped to manage external grant funding.

Internship programs designed to give students practical experience in their respective fields have allowed students to develop hands-on skills that will help them gain employment and address Malawi's development challenges. The **mentoring program** created by the partnership provided support to faculty on ways to address students' needs, and helped students communicate their challenges in more productive ways with faculty.

A **women's scholarship program** for third- and fourth-year female students in AgESS fields was created to assist disadvantaged women with academic funding. Fifteen of the scholarship recipients have already graduated. Based on a **study conducted** by partners on the conditions for women at Malawian partner universities, partners have contributed to changes in university policies that relate to advising and addressing female students' needs. The study helped to better understand why the gender gap in promotion and retention exists at each university and to strategize ways to assist women overcome their challenges and seize opportunities.

The **semester-long courses** and **modules** that were developed for the project integrated problem-solving, hands-on approaches and interdisciplinary perspectives, as well as gender-inclusive practices. These courses helped the Malawian university students understand the role of ecosystem services in agricultural production and environmental sustainability. The project also supported the creation of **gender-focused modules** at each partner university and one semester-long course on gender and development to be offered at LUANAR. Both the AgESS and gender-focused modules and courses will be integrated into the curricula at LUANAR and Chancellor College.

The **seed grant program** supported pilot research on AgESS-related topics and allowed faculty to identify and begin to address development challenges through pilot research studies. The seed grants were awarded to five teams of researchers from universities, NGOs, and the public sector to conduct pilot research in preparation for larger-scale research projects. Participatory research that engages academics and external stakeholders is critical to solving development challenges in Malawi.

The project was successful in bringing **public, private and NGO** sectors together to address identified national problems. Stakeholders engaged with their academic counterparts in fundraising workshops, stakeholder meetings, and research planning workshops. The relationships built between the various sectors could improve the relevance of teaching—providing students with the skills needed in the workforce, and enhancing communication between researchers, practitioners, and policymakers. The relationship between universities and external stakeholders was mutually beneficial for the students and the fifteen participating organizations. The students learned valuable on-the-job training, and the organizations were exposed to theory and a new generation of ideas.

Data in this report is based on semi-annual reports and a final report that were submitted by partners throughout the three-year period of implementation.

2. Partnership Overview

Background

This partnership was funded by the United States Agency for International Development (USAID) through a grant to American Council on Education, Office of Higher Education for Development (HED) as part of the Africa-U.S. Higher Education Initiative. The Initiative is a collaborative effort that was started in 2007 led by the Association of Public and Land-grant Universities (APLU) and by a number of higher education associations and other organizations to advocate for increased engagement in African higher education capacity development. Higher education institutions are among the most stable and sustainable institutions in Africa, with a huge potential to contribute to development of human and institutional capacities across a range of sectors.

The Government of Malawi (GOM), USAID and other international donors have highlighted areas of AgESS and Higher Education as key to resolving the most critical development issues facing Malawi today. The *Malawi Growth and Development Strategy* and the Ministry of Agriculture and Food Security's (MOAFS) *Agriculture Sector Wide Approach* (*ASWA*) identifies agriculture as the driver of the country's economic development and food security and risk management; commercial agriculture, agro-processing and market development; and sustainable agricultural land and water management. USAID/Malawi's *Feed the Future Implementation Plan* supports these directions. These interrelated agricultural development policies and initiatives all identify the critical role played by agro-ecosystems services—particularly sustainable land and water management—in food security and agricultural growth.

Uneven development, population growth, and climate change in Malawi and the southern African region have resulted in forest, soil, fisheries, and water degradation, which undermines sustainable agricultural and natural resource productivity and livelihoods. This partnership's focus on university capacity building in the area of agro-ecosystem services (AgESS) is central to strengthening LUANAR's and Chancellor College's ability to teach, conduct research, and carryout outreach to address such agricultural, environment, and development challenges.

In addressing the development challenges identified by the GOM and USAID, this partnership focused on the goal of increasing the number of women with undergraduate and advanced degrees in universities, government ministries and private firms in agricultural and environmental fields. Complementing USAID and GOM efforts to expand the leadership role of women in organizations along the value chain, the partnership included a strong focus on training women students and faculty in AgESS-related disciplines.

Goals and Vision

The goal of this partnership was to enhance capacities at Chancellor College/University of Malawi (UNIMA) and Lilongwe University of Agriculture and Natural Resources (LUANAR) to contribute to development in Malawi by strengthening teaching, research, and outreach in agro-ecosystem services-related fields to reduce poverty and spur agriculture-led economic growth.

Partnership Principles and Objectives

The partnership used four cross-cutting principles to guide activity development:

1) A holistic, interdisciplinary approach to education that addresses agricultural and environmental development challenges in Malawi and the region.
2) A problem-solving orientation to research and teaching, combining theory and practice to address critical ecosystem services (ESS) problems.
3) Institutionalized and sustained linkages between universities and ecosystem-related private, public, and NGO sector organizations.
4) Gender-related inclusiveness in staffing and ESS curricula to better reflect the interests of all sectors of society.

These guiding principles laid the foundation for all project activities and were central to the project's success and sustainability. The project began with six strategic objectives at its outset; however, these were transformed into five objectives during the project's second year of implementation. The final five objectives were:

1) Increased human capacity in AgESS-related fields at Chancellor College and LUANAR.

2) Improved institutional capacity for development and delivery of AgESS programs at Chancellor College and LUANAR.
3) Enhanced capacity in AgESS-related topics to obtain and manage outside research funding.
4) Strengthened college ability to engage with external stakeholders and provide outreach services to AgESS-related government, business and non-governmental organizations and natural resource extension training colleges.
5) Strengthened institutional environment for women faculty, administrators and students.

Collaborating Stakeholders

NGOs

- Kusamala Institute of Agriculture and Ecology, Mwera Mkaka Dairy Farmers Cooperative and Mzimba South District Farmers Union, Coordination Unit for Rehabilitation of Environment (CURE), Agricultural Research & Extension Trust; Department of Energy, WorldFish, Citizens for Justice, YouthNet and Counseling, Every Child, The Hunger Project, and Citihope.

Business

- Monsanto Malawi, Peacock Enterprises-Salima District, Ndatani Feeds-Lilongwe District and Ndatani Feeds-Dedza District, Green World Gardens-Lilongwe and Salima Districts, Auctions Holdings Limited, Electricity Supply Corporation of Malawi (ESCOM).

Government

- Department of Energy, Forest Research Institute of Malawi, Mangochi District Agricultural Office and Climate Change and Meteorological Services Department, Dowa District Agricultural Office, National Herbarium & Botanic Gardens, Bvumbwe Agricultural Research Station, Tobacco Control Commission, and Kusamala Institute of Agriculture and Ecology.

Universities

- UNIMA College of Medicine, Polytechnic, Kamuzu College of Nursing, Domasi College, Natural Resources College, Mzuzu University, Malawi College of Forestry and Wildlife.

3. Partnership Results and Performance

Structured around the partnership's M&E plan, this section examines the partnership's achievements and progress in relation to its objectives, outcomes and outputs. Results are presented based on performance against the partnership's targets for Higher Education Standard Indicators. Partners added several custom indicators during the second year of the partnership, which are measured against targets. Data in this report is based on semi-annual reports, a final report (**Appendix A**) and success stories (**Appendix B**) that were submitted by partners throughout the three-year period of implementation.

During the last two years of the partnership, HED utilized results-based management principles and a management information system (Partnership Results and Information Management Engine, or PRIME) to manage the performance of higher education partnerships. The HED reporting system, therefore, became more systematized and robust, in the second year of the partnership performance period, with data verification and substantiation of documents supporting data. The partnership's M&E plan and reporting in FY11 was not systematized affecting the quality of data and reports. The first half of the performance period, the partnership has been affected by several changes in USAID standard indicators and their definitions.

3.1 Achievements and Implementation Progress

Objective 1: Increased human capacity in AgESS-related fields at Chancellor College and LUANAR

Outcome: Faculty, students and other staff gain increased knowledge and skills in AgESS related programs

Long Term Training Completed

Partners established an undergraduate student scholarship program that targeted third and fourth year women students enrolled in B.S. and B.A. programs in AgESS-related disciplines. This activity addressed the gender disparities and the low number of women in these fields of study at LUANAR and Chancellor College. In addition to those listed in the chart below, several other students from Chancellor College are projected to complete their degrees in September 2014. Twenty students, nineteen of these female (Table 1) were supported by the partnership assisting them in successfully completing their bachelor's degree.

Table 1
Number of Individuals who Completed Long Term Training

End of Project Target	Program	End of Project Result		
		Male	Female	Total
20	Bachelor's Degree	1	19	20

During FY13, three students at Chancellor College who received scholarships through this partnership completed their Bachelor's degrees. During FY14, seventeen students who received scholarships or research grants through the partnership completed their Bachelor's degrees.

AgESS PhD Students Enrolled

The partnership supported two Ph.D. students enrolled in Michigan State University doctoral programs in AgESS fields; one female student in Fisheries & Wildlife, Madalitso Agather Magombo, and one male student in Crop & Soil Sciences, Placid Mike Mpeketula. While planning to support them throughout partnership implementation, the students secured external funding in 2013, which will support them through the end of their respective programs. They are making good progress towards the completion of their degrees.

Short Term Training

Over the life of the project, partners trained 411 (307 male, 104 female) individuals through short-term trainings (Table 2). The number of participants in the Payment Ecosystems (PES) training conducted in FY2011 could not be substantiated with documentation, such as sign-in sheets, but have been reported by partners and are therefore included in this report. Additionally, the number of participants for the library workshop was not disaggregated by gender and is only counted under the male category and in the total.

Table 2
Number of Individuals who Completed Short Term Training

	End of Project Result		
End of Project Target	Male	Female	Total
183	281+26	104	411

According to partners, the project's short courses, both in AgESS topics and in grants and financial management, had the most far-reaching impact, in terms of building capacities of faculty, staff and students in Malawi.

The AgESS short courses were three short courses that partners implemented in FY11, FY12, and FY14. The short courses trained 143 (110 male and 33 female) individuals and incorporated the four cross-cutting principles of the partnership. The purpose of the short course series was to strengthen human and institutional capacity in the area of agro-ecosystem services (AgESS). The first of the three courses was entitled, "Payment for Ecosystem Services" and its goal was to introduce payment for ecosystem services in the context of broader policies and approaches to promote conservation. The second short course was entitled, "Agro Ecology." Its purpose was to teach participants how to integrate theory and practice to support smallholder farmers in adopting sustainable production systems. The third short course, "Participatory Action Research" was added after the award was extended. It introduced participatory action research in the context of broader research and development to promote farmer ownership and farmer-to-farmer diffusion of innovations.

The capacity-building technical short courses were another example of the partnership's success. They trained 86 (72 male, 14 female) in grant writing, financial management, and fundraising. These courses were designed to build the capacity of academic and administrative staff in technical skills related to fundraising, proposal writing, and financial management, all of which have an impact on the effective management and implementation of projects, as well as the research capacity of the university. These short courses also had a strong outreach component, building the capacity of the university to more effectively engage with external stakeholders.

In addition to the two short course series, partners provided training through internship placements to 39 (18 male, 21 female) students. The internships provided students with hands-on experience with local organizations engaged in solving societal problems. The participants acquired skills and practical experience that will help them attain employment and help solve Malawi's development challenges.

An in-house training was held for college librarians in the use of new resources. Eight librarians (6 male, 2 female) participated in this training. Additionally, a one-day workshop was held at LUANAR for a group of over 26 librarians who came from various library and information centers throughout Malawi.

Partners engaged 61 (46 male, 15 female) faculty and 48 (29 male, 19 female) students in three mentoring workshops at Chancellor College and LUANAR. The dual approach to the mentoring workshops allowed facilitators to understand mentoring challenges from the perspectives of both students and faculty. The mentoring workshops paved the way for policy changes by initiating conversations around female students' needs and improving the conditions for women at Malawian institutions.

For many of the participants, the short-term training opportunities provided an entry point to become more engaged in the project and several participants furthered their involvement by participating in additional courses or research initiatives.

Students trained in Semester long AgESS Modules

In FY13, the partnership designed and delivered a qualitative research methods course at LUANAR. Twenty-five (15 male, 10 female) students participated (Table 3). Partners didn't meet the end of project target.

Table 3
Number of Students Trained in Semester-Long AgESS Modules

	End of Project Result		
End of Project Target	Male	Female	Total
67	15	10	25

The semester-long AgESS module 'Qualitative Methods in Agriculture and Environmental Sciences' was offered twice over the life of the partnership. The first time it was offered, eleven Master's students and five Ph.D. students participated. The second time it was offered, nine Master's students participated.

Objective 2: Improved Institutional Capacity for Development and Delivery of Ag-ESS programs at Chancellor College and LUANAR

Outcome: Strengthened academic offerings in AgESS related programs

Revised Curricula

Over the course of the partnership, partners developed several courses and modules with input from the private and public sector. These courses will form a part of the general coursework for the institutions or will be integrated into coursework for several departments. These courses are not part of a set curriculum (i.e., a set of courses leading to a degree).

AgESS Modules and Semester-Long Courses

Over the life the partnership, partners developed a total of five modules and semester-long courses related to AgESS (**Appendix C**), i.e., three semester-long courses and two course modules in AgESS-related areas (Table 4) exceeding the end of project target.

Table 4
Number of AgESS Modules and Semester-Long Courses

End of Project Target	End of Project Result
2	5

All of the modules and courses developed under this project integrated problem-solving, hands-on approaches and an interdisciplinary perspective. They were also gender-inclusive. The new courses and modules were designed to increase understanding of the role played by ecosystem services in agricultural production and environmental sustainability. The modules will be integrated into existing undergraduate and graduate-level courses. Some of the courses and modules, such as the Qualitative Methods in Agriculture and Environmental Sciences course and Payment for Ecosystem Services module, have already been offered to students, while others are awaiting approval to be integrated into the curriculum.

- AgESS Semester-long courses:
    1. Qualitative Methods in Agriculture and Environmental Sciences
        - The course is designed primarily to enable postgraduate students to acquire knowledge and skills in qualitative research methods and techniques for undertaking social science and development research. This course contributed to increasing LUANAR faculty's ability in the utility of qualitative methods in ecosystem- related research in agriculture and related fields. The qualitative research methods class has been offered twice at LUANAR. A total of 25 (15 male, 10 female) students have taken the course.
    2. Quantitative and Qualitative Data Collection Methods
    3. Systems Thinking and Practice in Rural Development
        - The course will be offered to Ph.D. students in Rural Development and Extension starting in the 2014 academic year.
- AgESS Modules:
    1. Payment for Ecosystem Services
        - This course is a new paradigm for natural resources conservations professionals and strengthens curricula offerings and forges new ties between the universities and stakeholders (public, private and NGOs). It also provided opportunities for faculty to acquire knowledge and approaches which positively impact their research, education and outreach engagement. This course has been offered as a full course to all third year students in all faculties starting in November 2013 at LUANAR.
    2. Agro-ecology

Short Courses Developed

Over the life of the partnership, partners developed six short courses, exceeding the end of project target (Table 5). Three of these courses were focused on AgESS-related topics, and the other three were dedicated to building technical skills in financial and grants management.

Table 5
Number of short course trainings developed

End of Project Target	End of Project Result
2	6

The short courses, both in AgESS topics and in grants and financial management, had the most far-reaching impact. The courses combined theory with practice in a hands-on, interactive environment. The short courses were multi-disciplinary and took a problem-solving approach to address current issues in Malawi and connected faculty members with colleagues in the NGO, public, and private sectors. Finally, the short courses were gender-inclusive, both in participant recruitment but also in the content delivered.

Payment for Ecosystem Services (PES): A New Paradigm for Natural Resources Conservation: During FY11, the partnership developed and offered an AgESS-related short course, PES, that is based around the concept that if certain individuals benefit from the ecosystem services that a land user provides, they will more likely be able to realize those benefits by compensating the land user for managing the land in a way that supports them. Thirty-five individuals (30 male, 5 female) participated in the course.

Agro-ecology: During FY12, partners developed and offered a short course on agro-ecology for faculty, graduate students, NGO, private and public sector personnel. This short course provided an overview of principles and practices underlying sustainable agriculture, with a special focus on participatory action research and extension in support of agricultural ecology. The format included lectures, small group work, and field exercises. Four faculty members (one from each partner institution), facilitated the short course and forty participants (33 male, 7 female) attended.

Grant identification/grant writing and financial management of grants: During FY12, partners also developed and delivered two technical short courses related to grant identification/grant writing and financial management of grants. The first was developed for faculty, students, and external stakeholders. The second was designed specifically for colleges' financial managers.

Fundraising and development: During FY13, the partnership developed a short course on fundraising/development. Twenty three participants benefitted from this training. This course exposed administrators to new ideas and strategies for creating linkages with external stakeholders, alumni, and potential donors. Attendees included top administrators (Vice Chancellors, Pro Vice-Chancellor, Principals, Deans, and Heads of Departments) from University of Malawi (Chancellor College, College of Medicine, Kamuzu College of Nursing, Polytechnic, and Domasi College) and Lilongwe University of Agriculture and Natural Resources.

Participatory Action Research: During FY14, four faculty members—one from each partnering institution (MSU, LU, LUANAR, and Chancellor College-UNIMA) co-developed the content for the short course on Participatory Action Research. The goal of this short course was to introduce participatory action research in the context of broader research and development, and to promote farmer ownership and farmer-to-farmer diffusion of innovations. Forty-three individuals from LUANAR and UNIMA participated in the four-day short course, in addition to representatives from NGOs, other Malawian tertiary institutions, and public and private sectors.

Experiential/Applied Learning

The partnership did not develop any degree programs. However, partners took an interdisciplinary approach and developed courses and activities with experiential and applied elements that will be incorporated into numerous degree programs. The partnership contributed experiential elements to both general education and several undergraduate and graduate degree programs.

For example, the partnership supported internship programs at both Malawian institutions to provide students with opportunities to gain practical experience in their chosen fields. A total of 39 students (18 male, 21 female) participated in four-week internships during the life of the project. Students interned at various organizations including, Peackock Enterprises, Ndatani Feeds, Green World Gardens, Mwera Mkaka Dairy Farmers Coop., and Mzimba South District Farmers Union. An initial review of the program by a team from LUANAR discovered that this was many students' first experience in hands-on farming techniques and many reported the internship opportunity improved their understanding of farming in Malawi. The only challenge reported was the short timeframe necessary to fit into the college's calendar. LUANAR has indicated that it will continue to offer the internship program after the grant cycle has ended.

Outcome: Increased availability of and access to AgESS-related library resources at Chancellor College and LUANAR

Library Resources

During the strategic planning phase for the project, partners discovered that one obstacle to capacity building in AgESS was a lack of access to up-to-date resources in the field. By upgrading library technologies and computers, the project was able to provide access to the most current research in the field and improve research capacity. Partners made seventeen purchases to improve library facilities at Chancellor College and LUANAR (Table 6).

Table 6
Library Resources Purchased

End of Project Target	End of Project Result
4	17

The following advancements were made to improve library infrastructure and librarian education at the host country institutions.

- The project purchased eGranary digital libraries for each of the universities that allowed access to over 30,000 current journal articles and other documents related to AgESS topics. Resources from the server are available to staff and students through the universities' intranet systems.

- The project purchased computer terminals and printers for each of the universities' libraries to provide their student population expanded access to online resources. The project also repaired and upgraded the LUANAR wireless network to expand access to wireless internet services on campus.
- An in-house training was held for college librarians in the use of new resources. Eight librarians (6 male, 2 female) participated in this training, and a one-day workshop was held at LUANAR for a group of over 26 librarians who came from various library and information centers throughout Malawi.

Objective 3: Enhanced capacity in AgESS related topics to obtain and manage outside research funding

Outcome: Enhanced abilities to obtain and manage AgESS-related outside funding

Joint Research
Over the life of the partnership, five joint research proposals received funding to continue research in AgESS areas **(Appendix D)**. The research pursued in the proposals was problem-oriented and interdisciplinary in nature.

1. USDA/USAID Trilateral Capacity Building Partnership project entitled "University-capacity building partnership among MSU, Tamil Nadu Veterinary and Animal Sciences University, and LUANAR."
2. NSF/USAID Partnership for Enhanced Engagement in Research grant (linking with an MSU/NSF project) entitled "Soil carbon distribution and dynamics in Malawi: a unique opportunity to optimize sustainable land use and enhance food security."
3. National Institutes of Health Fogarty grant for a project entitled "The Intersectoral Fellowships to Build Capacity on Irrigation, Agricultural Production, and Health in Malawi."
4. USAID-funded Global Center for Food Systems Innovation project entitled "Food security and sustainable livelihood through solar powered water pumping for irrigation and drinking water purification"
5. GCFSI Implementation Project Concept Note and Proposed Budget entitled "Creating a 'profile' of legume use, demand, and exchange in informal urban markets."

Partners also convened two research-planning meetings, organized an AgESS research conference, and developed and submitted 15 joint research proposals. All of these activities supported joint research among MSU, UNIMA, LUANAR, and LU faculty members. Additionally, a joint research team is working together to produce an edited book, which examines agricultural development issues and will be used to better prepare students in AgESS fields.

- Research Planning Meetings: The research planning meetings that were held at MSU brought together over 35 researchers from the four partner universities to discuss and plan major areas of potential collaboration. These included: agro-ecology; forestry and land use; fisheries ecology and management; and health and agriculture. The teams also planned research proposals for future submissions.
- AgESS Research Conference: The partnership held an AgESS research conference with 46 people in attendance. Fifteen research teams presented who were either recipients of the AgESS seed grants or were selected to write chapters in an edited volume that will be published out of this project (by MSU press). This edited volume will be a significant contribution to the agriculture and environmental literature on Malawi.

Research Proposals Submitted for Funding
Over the life of the partnership, partners submitted fifteen proposals for funding. Five were awarded funding **(Appendix D)**.

During FY11, a team of faculty members from MSU collaborating with Chancellor College, Bunda/LUANAR, and led by University of Minnesota, Duluth submitted a grant proposal to the National Science Foundation (NSF) entitled, "WSC-Category 2 Collaborative Research: Water Sustainability and Climate in the Great Lakes Region of East Africa."

During FY12, eight collaborative grant applications were submitted by MSU, UNIMA, and LUANAR related to areas of AgESS. The first two listed below were funded.

1. USDA/USAID Trilateral Capacity Building Partnership (for a university-capacity building partnership among MSU, Tamil Nadu Veterinary and Animal Sciences University, and LUANAR).
2. NSF/USAID Partnership for Enhanced Engagement in Research grant (linking with an MSU/NSF project in crop and soil sciences).
3. USDA Foreign Agricultural Service Scientific Cooperation Research Program (SCRP) grant proposal.
4. USAID Malawi Integrating Nutrition in Value Chains. MSU faculty were consulting on this project.
5. Four proposals for START research grants in Global Environmental Change in Africa.

During FY13, the partnership submitted two grant applications to support collaborative activities related to the partnership and two research proposals. The proposal to the National Institute of Health was awarded:

1. National Institutes of Health Fogarty grant for a project entitled "Intersectoral Fellowships on Irrigated Agriculture and Human Health in Malawi."
2. MacArthur Foundation's Conservation and Sustainable Development Program
3. ICRISAT (International Crop Research Institute for the Semi-Arid Tropics)
4. USAID-funded Global Center for Food Systems Innovation's Innovation Grants

During FY14, two proposals were submitted to the USAID-funded Global Center for Food Systems Innovation grant competition. Both proposals were awarded the competitive grant and focus on the following topics:

1. Food security and sustainable livelihood through solar powered water pumping for irrigation and drinking water purification.
2. GCFSI Implementation Project Concept Note and Proposed Budget: Creating a 'profile' of legume use, demand, and exchange in informal urban markets.

Seed Grant Awards
In FY12, partners developed a competitive research seed grant program for AgESS-related faculty which targeted interdisciplinary research. The teams were composed of a principal investigator from either Chancellor College or LUANAR and at least one member from an external organization. Proposals were peer-reviewed and selected based on their inclusion of problem-solving approaches, interdisciplinary methods, and gender concerns. Ten competitive proposals were submitted, and the evaluators selected five receiving $10,000 each in research funding (3 at LUANAR and 2 at Chancellor College). By the end of the partnership, the following five research projects were completed **(Appendix E)**.

1. *Extent of synthetic fertilizer and pesticide residues in agricultural eco-systems: A case of Chikwawa and Ntcheu vegetable production areas*. Miriam D. Joshua, Felistus P. Chipungu, Willard Kamowa-Mbewe, Charles Malidadi. Chancellor College
2. *The role of cropping systems in adaptation to effects of climate change and variability*. Wezi Mhango, Tasokwa Kakota, Donald Makoka and Vernon Kabambe. Lilongwe University of Agriculture and Natural Resources (LUANAR).
3. *Evaluation and promotion of the use of pesticidal plants among smallholder farmers in Malawi*. Lilongwe University of Agriculture and Natural Resources (LUANAR).
4. *Assessing sustainable livelihoods through natural resource management in flood prone areas – a link to climate change resilience*. Maguza-Tembo F., Zidana-Jere A. and Kamanga K. Lilongwe University of Agriculture and Natural Resources (LUANAR).
5. *Promotion of integrated water resources management practices in response to climate change in Malawi*. Wapulumuka O. Mulwafu, Cosmo Ngongondo, Samson M.I. Sajidu, and Russel C.G. Chidya. Chancellor College

Student Research Grants

Over the life of the partnership, partners awarded research grants to seventeen (five in FY12, 12 in FY14) students (3 male, 14 female) pursuing research in areas of AgESS (Table 7), exceeding the end of project target.

Table 7
Student Research Grants

End of Project Target	End of Project Result		
	Male	Female	Total
5	3	14	17

Objective 4: Strengthened college ability to engage with external stakeholders and provide outreach services to AgESS-related government, business and non-governmental organizations and natural resource extension training colleges

Outcome: Increased knowledge and skills of NGOs, private and public sector personnel in AgESS-related fields and grant management

Outreach/Extension activities

Partners reported three outreach activities that engaged external stakeholders (a) in project implementation and activities, (b) in a Stakeholder Meeting, and (c) in an internship program for undergraduate students (Table 8). Partners incorporated involvement of community members and external stakeholders throughout their activities.

Due to some confusion around indicator definitions, partners reassigned some of the activities previously included under this indicator, to custom indicators to capture the activity more accurately. For example, the Distinguished Speakers events that were originally to be reported under outreach/extension were reassigned to a custom indicator because it was decided that these events were better characterized as external stakeholders coming to the university rather than the host country institution disseminating knowledge to the community. The partners also reassigned the

internship programs, which were originally assigned to this indicator to be counted under short-term training.

Table 8
Outreach/Extension Activities

End of Project Target	End of Project Result
20	3

Inclusion of external stakeholders in activities. The project made a focused effort to include participants from external stakeholder organizations in project activities. This helped build bridges between the university and these organizations, and provided an opportunity for researchers from all sectors to interact around development challenges in Malawi.

- External stakeholders were represented in all of the AgESS short courses and on the seed grant research teams.
- Stakeholders also participated in the AgESS research conference in March 2014. Eight external organizations participated.

Convening of a Stakeholder Meeting. In order to promote a public-private advisory committee, the project convened an external stakeholder meeting to continue a dialogue between the universities and their constituents in the public, private and NGO sectors.

- Representatives from 10 organizations/institutions attended the meeting and participated in discussions.
- The Malawian project team prepared a report [**Appendix F**) on this meeting with recommendations for sustained engagement.

Engagement of stakeholders in an internship program for undergraduate students. The internship program was designed to give students practical experience in their respective fields. This was also in response to input from external stakeholders who wanted graduates who could bring theory to practice. This program is another way relationships were built between the community and the university.

- A total of 39 students (18 male, 21 female) participated in the internship program during the life of the project. They were placed in over 15 different organizations.

Outcome: Increased interest and commitment of public, private and nonprofit sectors in UNIMA activities

Advisory Board Meetings and Sustainability Plans Developed with Stakeholders

These activities were added to the work plan prior to realizing that the University of Malawi was about to undergo major administrative changes. Because of the departure of the pro-vice chancellor at UNIMA and the conversion of Bunda to a standalone university (LUANAR), an advisory committee was not formed as originally envisioned and sustainability plans were not developed. Partners navigated this challenge by channeling their resources into different activities that engaged stakeholders, i.e. stakeholder meetings, workshops, and short courses.

Distinguished Guest Speakers

Over the life of the partnership, LUANAR hosted three distinguished speaker events (Table 9).

Table 9
Number of Distinguished Speakers

End of Project Target	End of Project Result
4	3

Mr. Richard Chiputula from Competition and Fair Trading Commission of Malawi presented twice between FY13-FY14. The presentations focused on farmer mobilization to manage irrigation schemes. Thirty-two students from the Irrigation Scheme Management program attended the presentation. Mr. K. Niwa from the Japan Overseas Cooperative Association (JOCA) gave a presentation in FY13. His presentation was also on irrigation management with an emphasis on the role of government in implementing irrigation schemes using cooperatives. An estimated 300 participants, including external stakeholders, students, faculty and staff attended the three presentations.

Collaborating Stakeholders

Partners strengthened and expanded their engagement with stakeholders, including NGOs, businesses, government entities, and other educational institutions throughout the three years of the partnership. Table 10 below provides details on the type of collaborating organizations and descriptions on how they were involved with the partnership.

Table 10
Stakeholders Collaborating with the Partnership

Name	Type	Involvement
Natural Resources College; Mzuzu University; Malawi College of Forestry and Wildlife; UNIMA College of Medicine, Polytechnic, Kamuzu College of Nursing, and Domasi College	Educational Institutions	Natural Resources College, Mzuzu University, and Malawi College of Forestry and Wildlife had representatives who participated in the Participatory Action Research short course, the Agro-Ecology short course, the grant writing short course, and the AgESS Research Conference. UNIMA College of Medicine, Polytechnic Kamuzu College of Nursing and Domasi College participated in the fundraising short course.
Dowa District Agricultural Office; National Herbarium & Botanic Gardens; Bvumbwe Agricultural Research Station; Forestry Research Institute of Malawi; Mangochi District Agricultural Office and Climate Change and Meteorological Services Department; Department of Energy; Tobacco Control Commission	Government	Dowa District Agricultural Office had representatives who participated in the Participatory Action Research short course and Agro-Ecology short course. A representative from the National Herbarium & Botanic Garden participated in the AgESS Research Conference, Agro-Ecology short course, and grant writing short course. Representatives from Bvumbe Research Station, NTcheu District Agriculture Office, and Forest Research Institute of Malawi participated in the Agro-Ecology short course or grant writing short course. Mangochi District Agriculture Office and Climate Change and Meteorological Services hosted interns. The Department of Energy had a representative who participated in the Participatory Action Research short course. A representative from the Tobacco Control Commission participated in the grant writing short course.

Auctions Holdings Limited; Electricity Supply Corporation of Malawi (ESCOM); Monsanto Malawi Peacock Enterprises-Salima District, Ndatani Feeds-Lilongwe District and Ndatani Feeds-Dedza District; Green World Gardens	Business	A representative from Auctions Holding participated in the Participatory Action Research (PAR) short course, Agro-Ecology short course, and grant writing short course. A representative from ESCOM participated in the PAR short course, and a representative from Monsanto participated in the Agro-Ecology short course. Green World Gardens, Peacock Enterprises, Salima District, Ndatani Feeds Lilongwe District, and Ndatani Feeds-Dedza District hosted interns.
Kusamala Institute of Agriculture and Ecology; Coordination Unit for Rehabilitation of Environment (CURE); Agricultural Research & Extension Trust; WorldFish; Citizens for Justice; YouthNet and Counseling, Every Child, The Hunger Project, Citihope	NGO	Kusamala Institute of Agriculture and Ecology, CURE, and the Agricultural Research and Extension Trust had representatives who participated in the Participatory Action Research short course and Agro-Ecology short course. WorldFish and Citizens for Justice had representatives who attended and presented at the AgESS Research Conference. YouthNet and Counseling, Every Child, The Hunger Project, and Citihope hosted interns.
Mwera Mkaka Dairy Farmers' Cooperative and Mzimba South District Farmers Union	Community Organizations	Both of these organizations hosted interns.

Direct Beneficiaries

The partnership directly benefitted 722 (439 male, 283 female) individuals during the life of the project, significantly exceeding the end of project target (Table 11). For the LUANAR library workshop, participants were not disaggregated by gender and were counted under male participants. The numbers in Table 11 capture all individuals, including faculty members, students and staff that directly benefited from the partnership.

Table 11
Direct Beneficiaries

End of Project Target	End of Project Result		
	Male	Female	Total
265	413+26	283	722

The partnership developed and built capacity in AgESS-related science-for-development fields. The activities of the project linked extension work with communities for enhanced agricultural development. Partners connected community-based, small-scale "value-addition" activities with larger commercial markets. They tied multiple sectors together, with a strong emphasis on private-sector partners, to enhance strategic action in line with development priorities. Through tertiary education and research, partners sought to develop expertise and contribute to the development of a national mindset that

values environmental and agricultural development, and encourage sustainable exploitation of resources for food provision and economic growth. All participants in project activities indicated that they significantly benefitted from the trainings, scholarships, and research grants that the partnership provided. A significant outcome was the interaction of LUANAR and UNIMA faculty, staff, and students with individuals from the private, public, and NGO sectors. Additionally, this partnership focused on supporting female students and improving the conditions for women at the two universities.

Table 12

Direct Beneficiaries		End of Project Result		
	Activity	Male	Female	Total
Long term training	Ph.D. students enrolled in degree programs at MSU university	1	1	2
	subtotal	1	1	2
Short term training	Participants in the Agro-Ecology short course	33	7	40
	Payment ecosystems training	30	5	35
	Participants in the Participatory Action Research short course	32	11	43
	Students participating in the qualitative methods course that was designed under this project and piloted at LUANAR	15	10	25
	subtotal	110	33	143
	Participants in the grant writing short course	28	7	35
	Participants in the grants financial management training short course	14	1	15
	Participants in one-day financial management training at LUANAR and Chancellor college	8	5	13
	Participants in fundraising /development short course	22	1	23
	subtotal	72	14	86
	Students participating in internship programs at LUANAR and Chancellor College	18	21	39
	subtotal	18	21	39
	Participants in the Chancellor College mentoring workshop for faculty members	22	9	31
	Participants in the LUANAR mentoring workshop for students=	29	19	48
	Participants in LUANAR mentoring workshop for faculty members	24	6	30
	subtotal	75	34	109
	Librarians trained in new technology	6	2	8
	Participants in a Library training workshop at LUANAR	26		26
	subtotal	32	2	34
Research Grants	Students receiving student research grants	3	14	17
	subtotal	3	14	17
Scholarships	Recipients of the undergraduate female student scholarships	0	97	97
	subtotal	0	97	97
Workshops	Participants in research planning meeting at MSU	4	1	5
	Participants in research planning meeting at MSU	7	3	10
	Attendees at the stakeholder meeting	38	25	63

	Attendees at gender research dissemination workshop at Chancellor College	19	17	36
	Attendees at gender research dissemination workshop at LUANAR	24	11	35
	Participants in the AgESS Research Conference	36	10	46
	subtotal	128	67	195
	Total Beneficiaries,	**439**	**283**	**722**

Objective 5: Strengthened institutional environment for women faculty, administrators and students

Outcome: More favorable climate for colleges' women faculty, administrators, and students

Over the life of the partnership, partners took a comprehensive approach to gender inclusion. Partners prioritized equitable representation of men and women in project activities, and included a gender focus in both producing curriculum and in the content of all of the short courses.

The project supported the creation of two gender-focused modules that will be integrated into undergraduate courses at each partner university and one semester-long course on gender and development to be offered at LUANAR. Partners also investigated the conditions for women at the universities and held discussions with staff and administrators on how to improve access for women, but also to create a supportive environment, which would promote retention of women staff and students.

Another major achievement was the creation of a women's scholarship program for third- and fourth-year students in AgESS fields. This was one of the project's largest successes, as evidenced in the testimony of the female students who received these funds. Many of them would have left the universities without their degrees if they had not received the scholarship, which supported them through graduation. Finally, the project laid a foundation for creating a mentoring program that will take a holistic approach to supporting students beyond their academic studies.

Scholarships Awarded to Women

A total of 97 female students from LUANAR and Chancellor College benefited from partial or full scholarships during the life of the partnership, exceeding the end of project target (Table 13).

Table 13
Number of undergraduate scholarships awarded to female students focusing on AgESS-related areas

End of Project Target	End of Project Results
24	97

This activity was designed to address the low number of undergraduate women students enrolled in AgESS-related science-based fields at Chancellor College and LUANAR. This also addressed the guiding principle of gender inclusiveness and supported the strong gender focus of this project. The females selected were in their third and fourth years, and several of them were on the verge of dropping out of the university due to dire financial situations and family obligations. The scholarships supported them through their final years where 15 of them graduated, and were encouraged to continue in the field due to the support they received.

Access Policies

The partnership did not produce any new policies or procedures for new or improved access of disadvantaged groups (under this project defined as women) and have not met the end of project target for this indicator. They did however conduct activities that paved the way for future policies to improve access for women and the conditions for women at Malawian universities. Partners conducted research on the conditions for women at both universities, and the gender teams at each institution produced a report **(Appendix G)** that has been shared with top university administrators in dissemination events that were held during FY14. The partners' initial vision was for the original report to serve as a policy document, but it was realized that dissemination events and gaining input and "buy-in" from top administrators was a better, more sustainable approach. Through dissemination events and conversations with university leaders, these reports could serve as a foundation for policies and procedures on recruiting and retaining women students and staff in the future.

Additionally, each university held a mentoring workshop during FY14, which focused on developing a mentoring program to target disadvantaged populations (especially women staff and students). Positive feedback from the mentoring workshops provided the basis for future policy decisions regarding student mentorship practices.

Table 14
Number of Access Policies

End of Project Target	End of Project Results
4	0

Gender Focused Modules Developed

During the life of the partnership, partners developed one semester-long course and two modules that were focused on gender. The new courses and modules were designed to increase understanding of the role of gender within AgESS and environmental sustainability. The courses and modules will form a regular part of the university curriculum.

Semester-long courses developed:

1. Gender, Social Differentiation, and Development

Modules developed:

1. Gender, Agriculture, and Development
2. Gender, Environment, and Development

3.2 Challenges

1. Higher Education Challenges

Changes in the Universities' Structures and Administrative Leadership: One year into implementation, Bunda College split from the University of Malawi to become its own standalone university, Lilongwe University of Agriculture and Natural Resources (LUANAR). This caused delays in implementing some activities, as the leadership of the university and therefore the university's priorities changed. Moreover,

there was also a leadership change within the University of Malawi. This specifically affected the implementation of the planned public-private advisory committee. The UNIMA Pro Vice-Chancellor, who was also the project's Malawian PI, unexpectedly left the university and took a post elsewhere. He was overseeing the implementation of the public-private (external stakeholder) activities. This delayed the implementation of several activities related to public-private partnerships with the Malawi partner universities and caused slight delays in other activities because partners needed to transition to a different PI for the project. The Malawian project coordinators took on the responsibilities for the PI, and to address the issue of stakeholder engagement, partners planned a stakeholder workshop with cooperation of administrators from the two universities to build public-private relationships with the university.

Changes in Academic Calendars at Malawian Universities: Partners faced repeated changes in academic calendars throughout the life of the project due to strikes and closures. These changes meant that they had to remain flexible in terms of the timeframe for delivering activities.

Complex Procurement System at Chancellor College: The procurement procedures at Chancellor College were very complex and bureaucratic and caused delays in purchasing equipment, especially library equipment. Fortunately, the Chancellor College project coordinator and the librarian were able to negotiate the system and in the end the equipment was purchased and installed.

2. Program Management Challenges

Several Revisions to USAID/HED Reporting Requirements: One major challenge was the change in the USAID indicators and HED's reporting requirements/mechanism part way through project implementation. It was difficult for partners to shift their targets and indicators in the middle of the project and this made it very difficult to track the outputs and outcomes for the life of the project. Basically, the management team was asked to reshape the objectives and associated indicators and outputs several times which took time away from actual implementation. While this was onerous in terms of the amount of time it took, the project activities did not change significantly from the original work plan and they were able to deliver the project outputs that were originally envisioned and agreed upon by all partners during the strategic planning phase.

Changes in Per Diem Rates: During the last few months of the project's implementation, USAID/Malawi changed allowable per diem and transport rates for Malawian participants. This had the potential to create dissention between US and Malawian team members since the change in rates only affected Malawian partners. The project's implementation team tried to manage expectations of participants by proactively and clearly communicating the changes to all participants in the project's activities; however the rate change resulted in lower turnout than expected at the AgESS conference and stakeholder workshop because the new rates were not enough to cover meals at the hotel and other travel expenses.

3. Contextual Challenges

Fuel shortages: The fuel shortages in Malawi affected the ability of program coordinators to carry out activities in a timely way. This affected the ability of coordinators and team members to travel between the two universities as well as the ability of participants to travel to take part in short courses. To address the problem, the project coordinators had to adjust fuel allowance standard rates in line with the university's increased rates and asked participants to car pool when possible. Some meetings and activities were also rescheduled for when fuel was more available.

3.3 Lessons Learned

Transparency in Decision-Making and Budgeting: It was important for the entire management team, Malawian and US, to have all budgetary information and to participate in the decision-making processes throughout the planning and implementation phases. This contributed to a sense of joint ownership over the project and its outcomes. It is believed that mutual understanding and investment in the project could contribute to the sustainability of the project's outcomes, but also to a collaborative relationship amongst MSU, UNIMA, LUANAR, and LU. Along these lines, it was also important that partners used the same compensation, per diem, and transportation rates for host country and US personnel. This contributed to building trust and a sense of equality within the partnership. The change in USAID/Malawi rates that was mentioned above, negatively affected this shared commitment because partners were no longer able to provide equal rates to US and Malawian participants.

Integration of Project Objectives Into all of the Project Activities: While activities were organized under particular objectives, partners were able to find ways to integrate other objectives into the design of the activities to better contribute to the overall goal of the project. The partnership's four cross-cutting guiding principles guided partners throughout. For instance, through the AgESS short courses, partners contributed to building capacity in research, teaching, and engagement with external stakeholders. They also contributed to building awareness of gender issues and the importance of interdisciplinary. In this way, each activity contributed as much as possible to the project's overall success and reinforced other project activities.

Flexibility: The importance of flexibility was a major lesson that the project management team learned through the implementation of this project. As noted in the sections above, partners encountered several challenges, which forced them to change the timing for the delivery of several activities. Several issues that required flexibility were, (1) a complex procurement system that led to delays in purchasing library equipment, (2) fuel prices and calendar shifts that caused partners to reconsider when to offer particular trainings, and (3) the departure of the project's Malawian PI and UNIMA Pro-Vice Chancellor, which affected partners' delivery of certain stakeholder activities. In the end, all project objectives were met, but this was due to the diligence and adaptability of the project management team. Partners were able to navigate a complex landscape to deliver a quality program.

Commitment and ownership of the partnership program. The Chancellor, LUANAR and MSU partners have established a close working relationship with committed and dedicated partnership directors and academic staff on both sides. Partners demonstrated their commitment by the ability of to leverage funding, joint research projects and short term training of staff and faculty.

Collaboration toward efficient planning and implementation. Through a process evaluation, it was found that the approach to short course planning, curriculum development and course facilitation was empowering and participatory, creating an environment for good collaboration among implementing stakeholders and course participants. This was clearly demonstrated through a process evaluation conducted by HED, MSU and Malawian partners **(Appendix H)**. The short course preparation process was well managed and the content was timely and relevant. Evaluation results show that there was consistent and positive engagement of stakeholders from the planning grant stage through the implementation of the AgESS short courses (and afterwards). Their engagement contributed to the relevance and smooth running of the AgESS short courses.

6. Sustainability

This partnership planted the seeds for sustainable growth in the following areas.

Human Capacity Development: Participation of faculty from LUANAR and Chancellor College in training faculty and students will have a lasting influence on strengthening local capacity and creating the ability to conduct trainings on a continuous basis using local or in-house experts. The fundraising workshop, stakeholder meeting, and research planning workshop forged new ways for the university to build sustainable relationships with external stakeholders to improve the relevance of teaching and enhance communication among researchers, practitioners, and policymakers. This partnership introduced a problem-solving orientation towards teaching and learning. Partnership activities brought social scientists and natural or agricultural scientists together to work on development challenges. This led to a more comprehensive/interdisciplinary approach to develop solutions to AgESS problems. These approaches will be passed on to future educators and students in the future. Furthermore, the internship program provided students with an experiential learning opportunity that will help them find employment and contribute to Malawi's national development.

Institutional Capacity Development: Partners were successful in building bridges between the university and the public, private, and NGO sectors. This occurred through project activities where participants from the government, private sector and NGOs worked alongside university researchers to explore potential solutions to development problems in AgESS areas. The outcome of the final stakeholder workshop was to produce a report with recommendations for university administrators to act upon to maintain the linkages between the public and private sectors that developed through this project. The Report (**Appendix F**) illuminated the need for continuous collaboration between Malawian institutions and stakeholders to increase the productivity of the Malawian workforce. Key findings included the need for practical and applicable research, on-the-job training through internships and guest lecture series, creative funding schemes for skills-building and action research, and a higher education policy that links the needs of the institutions and stakeholders.

Research: Partners contributed to the field of AgESS and strengthened the level of scholarship at LUANAR and UNIMA through this partnership. The AgESS Research Conference broadened collaborative relationships toward problem solving research and exposed Malawian universities to external financial support. The ability of partners to leverage resources through grant proposal writing for funding collaborative research projects contributes to sustainability of the partnership program and its objectives. Additionally, the seed grant recipients included participants from the external sector, thereby creating an opportunity for researchers to connect with colleagues outside the universities and continue their research beyond the close of the partnership.

Gender Inclusive Policy: A major impact on the host-country institutions relates to gender inclusivity and support for women. Several recipients of the project's women's scholarship were on the verge of dropping out of the university due to dire financial situations and family obligations. The scholarships supported them through their final years, many of them graduated, and they were encouraged to continue in the field due to the support they received. Moreover, outcomes of the research studies carried out under this project caused university administrators and faculty members to regard gender-inclusiveness not just in terms of access, but also in terms of the institutional environment for women. Both universities are currently working on policy changes that will address gender concerns. One example is the mentoring program at LUANAR, which is reshaping how the university will approach

undergraduate student mentoring. The new program will now take into account the full range of student needs—academic and personal—and will take a gender-sensitive approach.

Leveraging Resources: The capacity to leverage funding was vital for the partnership's success. The ability to secure funding allowed the partners to continue with implementation and ultimately meet most of its targets. The continued relationship between Chancellor, LUANAR and MSU will help expand host country capacity to secure funds for future projects and sustainability of the program goals.

Mutually Beneficial Collaboration: The collaboration between MSU and partners at UNIMA and LUANAR will continue far beyond the life of the project. MSU has maintained a nearly 30-year-long relationship with these institutions and several opportunities for future engagement are already planned. There are several ongoing grant projects between individual faculty members, and MSU's Global Center for Food Systems Innovation selected LUANAR as one of their hubs and just launched their initiative. Many members of the AgESS project team are also collaborating with Malawian colleagues to produce an edited book, which examines AgESS issues. This book will capture much of the research that was conducted under the AgESS project and will lay out an agenda for future research activities. There is no doubt that MSU will continue to support the strategic partnership with UNIMA and LUANAR that was formally established in 2008. MSU is dedicated to expanding work with Malawian institutions and Malawian institutions have expressed their commitment to engage with MSU.

7. Success Stories

Among the many individual benefits and successes that have occurred because of the MSU-Malawi partnership, three stories are highlighted in this report (refer to **Appendix B** for detailed stories):

1. **Impacting the Success of Disadvantaged Women Undergraduate Students in Malawi: Tenacity Rewarded**. The story of Stiveria Ndala represents the challenges that disadvantaged women experience in their academic life in Malawi, as well as the successes that can be achieved with a small amount of support. Stiveria Ndala joined Bunda College of Agriculture to pursue a Diploma/Degree program in Agriculture in the 1990s. Struggling to complete her studies and support herself, she left the university after three years of study and went out to seek employment. While working at an NGO, Stiveria became a mother and took on the responsibility of being a bread winner for her family. In 2010, Stiveria again applied to a Degree Program at Bunda College of Agriculture to continue her education. The scholarship that she and other women received through the USAID-funded Agro-Ecosystem Services University Capacity Building project had a considerable impact on her life in terms of professional and personal success.

2. **New avenues to the future through a scholarship program: Masaka's Story.** Ennipher Masaka's story is an example of how a relatively small amount of support for a motivated and bright student can have a big impact. Most often, issues of family and finances play a major role in women's decisions to drop out. Ennipher was on the verge of leaving the university, but she received a scholarship and was able to complete her program and graduate. She had goals of using her degree to contribute to agro-ecosystem related education in Malawi. With this scholarship, Ennipher was able to stay in school, complete her degree, and gain new avenues to future employment.

3. **Participatory Action Research in Malawi: Increasing Capacity for Problem-Solving and Community Engagement in Agro-Ecosystem Services.** Forty-three participants from the two Malawian partner universities, local NGOs, private industry, and the government sector attended a five-day short on Participatory Action Research in Malawi. The short course introduced new methods of learning and critical thinking. One participant stated, "I have a natural scientist's background but the problems faced by communities are both social and concerning natural science, so I will utilize the skills and information acquired to fill the gaps which exist between natural and social scientists." Another noted the importance of community participation, "PAR is a tool that helps the exchange of ideas and knowledge in recognition that both researchers and farmers have something to learn from each other". The partners integrated their core principles of holistic, inter-disciplinary, and problem-solving teaching methods to encourage creativity and practicality in addressing development challenges.

8. Appendices

Appendix A: Michigan State University-Chancellor College-LUANAR Final Report

Higher Education for Development (HED)
Final Partnership Report

Project dates: April 3, 2011-May 30, 2014

Agro-Ecosystem Services: Linking Service to Action in Malawi and the Region

A Partnership of:
Michigan State University
Lincoln University
University of Malawi (UNIMA), Chancellor College
Lilongwe University of Agriculture and Natural Resources (LUANAR), Bunda

Partnership Overview

MSU has had a long-standing relationship with the University of Malawi and what is now Lilongwe University of Agriculture and Natural Resources (formerly Bunda College of Agriculture). This relationship has involved numerous faculty members from many disciplines at each institution over more than twenty-five years. In 2008, the University of Malawi was identified as a key partner for MSU and the relationship was formalized as one of MSU's International Strategic Partnerships. Building on this relationship, MSU, The University of Malawi, Chancellor and Bunda Colleges and Lincoln University embarked on a strategic planning process as part of the USAID/HED African university capacity-building initiative. During this process, the strategic planning team, with members from each partner institution and in consultation with external stakeholders, identified agro-ecosystem services as a critical area for development. Given this focus, the team developed a five-year strategic plan which resulted in a USAID/Malawi associate's award for a $1.1 million 2-year university capacity-building project entitled *Agro-Ecosystem Services: Linking Science to Action in Malawi and the Region*. This project was extended to a total of $1.4 million and 3 years (April 5, 2011-May 30, 2014). The final budget included $1,140,000 in award funding and $320,000 in cost share.

Partnership Context: Agro-Ecosystem Services and the Development Context in Malawi

The specific goal of this project was to enhance the capacities of Bunda College of Agriculture (now Lilongwe University of Agriculture and Natural Resources—LUANAR) and University of Malawi (UNIMA), Chancellor College to respond to faculty development, research, curricula and outreach needs identified by government, the colleges, private sector, and non-governmental organizations (NGOs) in the area of agro-ecosystem services (AgESS)—the benefits that ecosystems provide to people and the environment. This focus grew out of meetings held with college administrators and faculty and initial stakeholder meetings with representatives of twenty agriculture and natural resource-related private businesses, government ministries, and non-governmental organizations during the six-month Planning Grant period. All of the stakeholders that the planning team consulted recognized that the emerging global knowledge economy requires an increasingly educated population. They also acknowledged that a strong university system is critical to Malawi's continued development. Representatives from the colleges, businesses, government ministries and NGOs that attended the stakeholder meetings strongly endorsed the need for closer collaboration between their respective sectors to enhance Malawi's agriculture-led growth and the colleges' capacities to contribute to it. They endorsed the focus on agro-ecosystem services as central to this effort.

The focus on agro-ecosystems responded to targeted development challenges identified in the *Malawi Growth and Development Strategy* (*MGDS*), the Ministry of Agriculture and Food Security's (MOAFS) *Agriculture Sector Wide Approach* (*ASWAp*) and the *Greenbelt Initiative*. The *MGDS* identifies agriculture as the driver of the country's economic development. The MOAFS *ASWAp* identifies food security and risk management; commercial agriculture, agro-processing and market development; and sustainable agricultural land and water management as areas essential for promoting agricultural growth. The MOAFS *Greenbelt Initiative* aims to intensify irrigation farming, livestock development and fisheries development through sustainable water and land use management strategies. Both *ASWAp* and the *Greenbelt Initiative* are in line with the *Comprehensive Africa Agricultural Development Plan* (*CAADP*) goals. USAID/Malawi's *Feed the Future Implementation Plan* supports these directions. These interrelated agricultural development policies and initiatives all identify the critical role played by agro-ecosystems services—particularly sustainable land and water management—in food security and agricultural growth. The project team took this focus and weaved it into the project's work plan to build the capacity of the partner universities in research, teaching, and outreach in this critical area.

Guiding Principles and Project Objectives

The project used four cross-cutting, guiding principles when developing activities for its three-year work plan to transform university education, making it more responsive to Malawi's agricultural and natural resource-based development strategies and the government ministries, businesses and NGOs that implement or are affected by them:

1) A holistic, interdisciplinary approach to education that addresses the AgESS development challenges outlined in the Problem Statement (Sec. 4). University education is generally disciplinary-focused and thus often has difficulty addressing complicated problems crossing several fields of study.
2) A problem-solving orientation to research and teaching, combining theory and practice to address critical AgESS development-related problems. This contrasts with the focus on theory building and the lack of appreciation for applied, problem-solving orientations found in many academic fields.
3) Institutionalized and sustained linkages between universities and agro-ecosystem-related private, public, and NGO sector organizations and businesses. UNIMA colleges have not systematically pursued these relationships in the past, as their mission and goals have generally focused inward on discipline-oriented debates.
4) Gender-related inclusiveness in staffing and AgESS curricula to better reflect the interests of all sectors of society. Women and men often bring different perspectives to bear on issues like food and livelihood security and natural resource management, perspectives which need to be included in research and the curriculum. In particular, women remain underrepresented in AgESS science-based fields, thus potentially biasing the questions typically asked in research or topics covered in class.

These guiding principles laid the foundation for all project activities and were the key to the project's success and sustainability.

The project began with six strategic objectives at its outset; however, these were transformed into five objectives during the project's second year of implementation. The final five objectives were:

6) Increased human capacity in AgESS-related fields at Chancellor College and LUANAR.
7) Improved institutional capacity for development and delivery of AgESS programs at Chancellor College and LUANAR.
8) Enhanced capacity in AgESS-related topics to obtain and manage outside research funding.
9) Strengthened college ability to engage with external stakeholders and provide outreach services to AgESS-related government, business and non-governmental organizations and natural resource extension training colleges.
10) Strengthened institutional environment for women faculty, administrators and students.

Partnership Activities and Most Significant Achievements

The partnership activities included training two faculty members from the Malawian partner institutions in AgESS areas to the Ph.D. level; delivering short courses in AgESS topical areas, grant writing, fundraising, and financial management; developing new curricula focused on AgESS and on gender issues; engaging external stakeholders through a distinguished speakers series, a student internship program, a stakeholder workshop, and including representatives from the public and private sector in the short courses and seed grant teams; increasing access for women through a female student scholarship program; addressing conditions for women on campus through research that resulted in policy recommendations and mentoring trainings; improving the capacity of the universities libraries by

providing trainings and new equipment.

The most significant achievements are grounded in the project's four guiding principles. Below are some examples:

1) The project's short courses, both in AgESS topics and in grants and financial management, had the most far-reaching impact. They helped faculty members expand their knowledge in critical topics in order to improve their teaching and research skills. The courses took a problem-solving orientation to address current issues in Malawi and connected faculty members with colleagues in the NGO, public, and private sectors. Since participants came from a variety of fields, the courses allowed them the opportunity to approach problems from multiple perspectives and formulate an integrated approach to solving them. Finally, the courses were gender-inclusive, both in participant recruitment but also in the content delivered. Feedback on the courses from participants verifies their success.
2) The gender conversations that occurred during the short courses and especially during the gender research dissemination events are helping to expand faculty and administrative staff's perspective from a focus on increasing access to a more comprehensive understanding of the conditions for women at the university.
3) Student development improvements took place through the women's scholarship program, which contributed directly to retention of women in AgESS fields, internship and student research programs which gave students practical experience, and trainings in mentoring which have led to a reconceptualization of student mentoring at each partner institution.

Impact on Host-Country Development and Prospects for Sustainability

As with the project successes, the project's impact on host-country development can be framed in the project's guiding principles. Related to principle number three, institutionalized linkages with the public, private and NGO sectors, the project was successful in bringing public and private sectors together to address identified national problems. This occurred through the short courses where participants from the government, private sector and NGOs worked alongside university researchers to gain the latest knowledge in AgESS fields and to explore potential solutions to development problems in this area. Additionally, the seed grants included participants from the external sector and facilitated pilot studies in critical development areas. Finally, the fundraising workshop, stakeholder meeting, and research planning workshop forged a new way for the university to build sustainable relationships with external stakeholders to improve the relevance of teaching—providing students with the skills needed in the workforce, and enhancing communication between researchers, practitioners, and policymakers. The outcome of the final stakeholder workshop was to produce a report with recommendations to be acted upon to maintain the linkages between the public and private sectors that have begun to develop through this project.

Another major impact on the host-country institutions relates to gender-inclusivity and support for women entering the sciences. Several recipients of the project's women's scholarship were on the verge of dropping out of the university due to dire financial situations and family obligations. The scholarship supported them through their final years, many of them graduated, and they were encouraged to continue in the field due to the support they received. Moreover, outcomes of the research studies carried out under this project, caused university administrators and faculty members to regard gender-inclusiveness not just in terms of access, but also in terms of the institutional environment for women. Both universities are currently working on policy changes that will address gender concerns.

Finally, the research skills that participants gained through the project activities—short courses and seed grants—will help researchers continue on-going work in Malawi that will contribute to solving critical development problems recognized by USAID and the national government. Several researchers

who participated in this project have received funding to continue research in AgESS areas. Many members of the project team are also collaborating with MSU researchers to produce an edited book which examines these issues and will be used to better prepare students in AgESS fields.

Partnership Results

The MSU-UNIMA-LUANAR-Lincoln partnership capacity-building project achieved all of its major targets and has had a significant impact on all of the partner institutions. The overall goal of the project was to enhance the capacities of LUANAR and Chancellor College to respond to faculty development, research, curricula and outreach needs identified by the government, the colleges, private sector, and non-governmental organizations (NGOs) in the area of agro-ecosystem services (AgESS)—benefits that people derive from ecosystems. With the completion of the activities under each objective listed earlier in this report, the partnership met this goal.

Major achievements can be generally organized under key areas of capacity-building (research, teaching/curriculum/student services, and outreach/engagement) although it should be noted that all of these areas are interconnected and that the project activities were each designed to address multiple areas of capacity-building within the same activity. Each of the activities were also designed in accordance with the guiding cross-cutting principles outlined above (interdisciplinary, problem-solving orientated, linked with external stakeholders, and gender-inclusive). Adherence to these principles and a comprehensive, integrative approach were key to the project's success.

Key Achievements

Research

The development and delivery of three AgESS-topical short courses. These short courses were designed to strengthen human and institutional capacity in the area of agro-ecosystem services (AgESS) at each of the universities. They expanded knowledge in AgESS and exposed faculty to new strategies and resources, making the universities better equipped to address development challenges through improved research, teaching, and outreach. We are including these courses in the general category of research capacity-building, but they also had a significant impact on improving teaching skills and providing opportunities to engage with external stakeholders.

- The short courses were in key areas of agro-ecosystem services on the cutting edge of research in this field: Payment for Ecosystem Services; Agro-ecology; and Participatory Action Research.
- The design and teaching of the courses integrated all elements of the guiding principles of the project: problem-oriented; interdisciplinary; engaged with the private, NGO, and public sectors; and gender-inclusive (both in terms of access and content).
- A total of 127 (28 female/99 male) participants took part in the three short courses. The evaluations of the short courses indicated a high level of satisfaction amongst the participants.

The development and delivery of three capacity-building technical short courses in grant writing, financial management, and fundraising. These courses were designed to build the capacity of academic and administrative staff in technical skills related to fundraising, proposal writing, and financial management, all of which have an impact on the research capacity of the university. Of course, these short courses also had a strong outreach component, building the capacity of the university to more effectively engage with external stakeholders.

- The short courses took a practical, hands-on approach. For example, in the grant writing course, teams of researchers produced a concept note that they then could turn into a full research grant proposal. Several of these teams applied for the project's seed grant programs, and five of them were awarded these grants.

- The fundraising course exposed administrators to new ideas and strategies for creating linkages with external stakeholders and alumni.
- The financial management course trained financial staff from the universities on how to better manage any external grant funds that their faculty members receive, potentially bringing additional funds to the universities.
- A total of 81 (12 female/69 male) participants took part in the three short courses. The evaluations show that these participants were very satisfied with the content of the courses.

The convening of two research planning meetings, submission of joint research proposals, and organization of an AgESS research conference. All of these activities supported joint research among MSU, UNIMA, LUANAR, and LU faculty members. The research pursued in the proposals and planning meetings was problem-oriented and interdisciplinary in nature.

- The research planning meetings that were held at MSU brought together over 35 researchers from all partner universities to discuss and plan major areas of potential collaboration. These included: agro-ecology; forestry and land use; fisheries ecology and management; and health and agriculture. The teams also planned research proposals for future submissions.
- During the grant period, collaborative teams of researchers from the partner universities submitted 15 research proposals to a variety of funding organizations including the NSF, USDA, MacArthur Foundation, and USAID. Five of these grants were awarded.
- The project held an AgESS research conference with 46 people in attendance. Fifteen research teams presented who were either recipients of the AgESS seed grants or were selected to write chapters in an edited volume that will be published out of this project, published by MSU press. This will be a significant contribution to the agriculture and environmental literature on Malawi.

Implementation of a research seed grant program. This seed grant program supported pilot research on AgESS-related topics and is likely to lead to further research supported by external grant funding.

- Five teams of researchers were awarded these small grants of $10,000. The teams were composed of a principle investigator from either Chancellor College or LUANAR and at least one member from an external organization. Proposals were peer-reviewed and selected based on their inclusion of problem-solving approaches, interdisciplinary methods, and gender concerns.

Carrying out research on the conditions for women at Malawian partner universities. In order to understand why the gender gap in promotion and retention exists at each university, the project supported research into the challenges and opportunities women face in their work lives at the universities and their strategies for negotiating them.

- Gender teams were formed at each university to carry out the research. They designed a survey instrument/interview protocol and carried out research to understand the conditions for women at the universities.
- The teams each produced a report on the findings of this research for their respective institutions. They then held research dissemination workshops with faculty members and administrators to discuss the implications of the research findings and make policy recommendations.

Teaching, Curriculum, and Student Services

Development of new courses and modules in AgESS and gender topics. The new courses and modules were designed to increase understanding of the role played by ecosystem services in agricultural production and environmental sustainability, and they will form a regular part of the university curriculum. Some of the courses and modules have already been offered to students, while others are awaiting approval to be integrated into the curriculum. Modules developed for courses will be integrated into existing undergraduate and graduate-level courses.

- Under this project, four semester-long courses and four course modules were developed. All of the curricula developed under this project integrate problem-solving, hands-on approaches and an interdisciplinary perspective. They also are gender-inclusive.
- Semester-long courses were:
  - Qualitative Methods in Agriculture and Environmental Sciences
  - Quantitative and Qualitative Data Collection Methods
  - Gender, Social Differentiation, and Development
  - Systems Thinking and Practice
- Modules were:
  - Gender, Agriculture, and Development
  - Gender, Environment, and Development
  - Payment for Ecosystem Services
  - Agro-ecology
- The qualitative research methods class has already been offered twice at LUANAR. A total of 25 (10 female/15 male) students have taken the course.

Development and Implementation of an Internship Program for LUANAR and Chancellor students. In keeping with the guiding principle of a problem-oriented approach, the internship program was designed to give students practical experience in their respective fields. This was also in response to input from external stakeholders who wanted graduates who could bring theory to practice.

- A total of 38 students (23 female/16 male) participated in the internship program during the life of the project.
- An initial review of the program by a LUANAR team found that this was many students' first experience in hands-on farming techniques and many reported the internship opportunity improved significantly their understanding of farming in Malawi. The only challenge reported was the short timeframe necessary to fit into the college's calendar.
- LUANAR has indicated that it will continue to offer the internship program after the grant cycle has ended.

Implementation of a scholarship program for female students. This activity was designed to address the low number of undergraduate women students enrolled in AgESS-related science-based fields at Chancellor College and LUANAR. This also addresses the guiding principle of gender inclusiveness and supports the strong gender focus of this project.

- A total of 97 female students from LUANAR and Chancellor College benefited from partial or full scholarships. The students selected were in their third and fourth years. The goal was to contribute to the retention of female students through their graduation. 15 female students graduated within the project's timeframe and several more are expected to graduate by September 2014.

Delivery of a mentoring training for faculty and students at LUANAR and Chancellor College. During the course of the project, it was posited that the students supported through our scholarship and internship programs were in need of further support. A mentoring program was proposed by staff member at the partner universities and a mentoring training was designed at delivered at each institution. This program and the training were designed to be "gender-sensitive" in support of our gender-inclusive guiding principle.

- These workshops trained faculty members in mentoring skills and engaged students in understanding and defining the mentoring process.
- 61 (15 female/46 male) faculty members and 48 (19 female/29 male) students participated in the mentoring training sessions.

- The mentoring workshop at LUANAR has produced significant changes in advising policies at the university, which now take into account the full range of student needs—academic and personal.

Improvement of library services and resources in AgESS-related fields. During the strategic planning phase for the project, it was found that one obstacle to capacity-building in AgESS was a lack of access to up-to-date resources in the field. By upgrading library technologies and computers, the project was able to provide students and faculty members access to the most current research in the field.

- The project purchased eGranery digital libraries for each of the universities and they have made the resources from the server available to staff and students through the universities' intranet systems.
- The project purchased computer terminals and printers for each of the universities' libraries to provide their student population expanded access to online resources. The project also repaired and upgraded the LUANAR wireless network to expand access to wireless internet services on campus.
- An in-house training was held for college librarians in the use of new resources. Eight librarians (2 female/6 male) participated in this training, and a one-day workshop was held at LUANAR for a group of over 26 librarians who came from various library and information centers throughout Malawi.

Outreach and Engagement with External Stakeholders

Inclusion of external stakeholders in activities. The project made a focused effort to include participants from external stakeholder organizations in project activities. This helped build bridges between the university and these organizations, and provided an opportunity for researchers from all sectors to interact around development challenges in Malawi.

- External stakeholders were represented in all of the AgESS short courses and on the seed grant research teams.
- Stakeholders also participated in the AgESS research conference in March 2014. Eight external organizations participated.

Convening of a Stakeholder Meeting. Due to the challenge of establishing a public-private advisory committee, as outlined in the implementation challenges section below, the project convened an external stakeholder meeting to continue a dialogue between the universities and their constituents in the public, private and NGO sectors.

- Representatives from 10 organizations/institutions attended the meeting and participated in discussions.
- The Malawian project team prepared a report on this meeting with recommendations for sustained engagement.

Engagement of stakeholders in an internship program for undergraduate students. The internship program was designed to give students practical experience in their respective fields. This was also in response to input from external stakeholders who wanted graduates who could bring theory to practice. This program is another avenue to build relationships between stakeholder organizations and the university.

- A total of 39 students (23 female/16 male) participated in the internship program during the life of the project. They were placed in over 15 different organizations.

Development Outcomes and Impact of the Partnership

The development outcomes of the project are in line with its objectives and can be best framed in terms of its guiding principles. First, we made significant progress in building linkages between the

university and external stakeholders in the government, NGO, and private sectors. As discussed under the "key achievements" section of this report, we had several achievements in outreach and engagement with stakeholders in these sectors. We included members from organizations outside of the universities in our short course sessions. The seed grant teams paired researchers from the universities with those from NGOs and the public sector to conduct pilot research in preparation for potential large research grants. We invited representatives from these and other organizations and institutions to the research conference held in March 2014. At this time we engaged them in discussions to plan future research activities and connect research with development policies. To further these types of conversations, the project team held a stakeholder meeting in April 2014 to forge sustainable links between the universities and external partners so that this aspect of the project would continue after the life of the grant. These discussions resulted in a report which outlines steps and recommendations for sustained engagement. Moreover, the Malawian project coordinators organized distinguished speaker talks which brought researchers and implementers from the NGO and public sectors to their respective campuses to present their work and meet with students. These events served to educate students on practical applications and current trends in AgESS-related fields as well as to familiarize the presenters with the work that the universities are doing in this area. In total, the project engaged stakeholders from 40 external organizations, institutions, and government ministries.

Other major development outcomes are related to gender-inclusiveness. This project took a comprehensive approach to gender inclusion that went beyond simply recruiting more women's involvement. While we did take very seriously equitable representation of men and women in our project activities, we also included a gender focus in both producing curriculum and in the content of all of the short courses. The project supported the creation of two gender-focused modules that will be integrated into undergraduate courses at each partner university and one semester-long course on gender and development to be offered at LUANAR. We also investigated the conditions for women at the universities and held discussions with staff and administrators on how to not only improve access for women, but to create a supportive environment which will promote retention of women staff and students. Another major achievement was the creation of a women's scholarship program for third- and fourth-year students in AgESS fields. As mentioned earlier, a total of 97 scholarships were given and 15 students have already graduated. This was one of the project's largest successes, as evidenced in the testimony of the female students who received these funds. Many of them would have left the universities without their degrees if they had not received the scholarship which supported them through graduation. Finally, the project lent support to creating a mentoring program that will take a holistic approach to supporting students beyond their academic studies.

The project's problem-solving orientation contributed significantly to its positive development outcomes. The topics chosen for the AgESS short courses came out of real, pressing issues that Malawi is currently facing. The government, NGO, private sector and university researchers alike has recognized these problems and the short courses were an opportunity for them to come together, gain exposure to the most current knowledge, and have the chance to apply the skills they learned in the field. The seed grant program allowed faculty to identify and begin to address development problems through pilot research studies. The internship program and student research grants allowed students to have experiential learning opportunities that help create the hands-on skills that they will need to gain employment to help solve Malawi's development challenges.

Finally, the interdisciplinary approach of the project helped to forge new ways of thinking about and responding to development projects. In many cases, this was a rare opportunity for social scientists and natural or agricultural scientists to come together and work on development problems. Research teams were expected to be interdisciplinary, the short courses brought together both instructors and participants from a wide range of backgrounds, and the curriculum created took an interdisciplinary

approach. This led to a more comprehensive research and teaching approach that drew on multiple disciplines to propose development solutions to AgESS problems.

Challenges to Implementation

The project team encountered several implementation challenges throughout the life of the project; however, for the most part we were able to successfully navigate these challenges to deliver project activities and outputs. One major challenge was that USAID changed their reporting indicators and HED changed their reporting requirements/mechanism part way through project implementation. It was difficult for the team to shift their targets and indicators in the middle of the project and this made it very difficult to track the outputs and outcomes for the life of the project. Basically, the management team was asked to reshape the objectives and associated indicators and outputs several times which took time away from actual implementation. While this was onerous in terms of the amount of time it took, the project activities did not change significantly from the original work plan and we were able to deliver the project outputs that were originally envisioned and agreed upon by all partners during our strategic planning phase.

Additionally, during the last few months of the project's implementation, USAID/Malawi changed allowable per diem and transport rates for Malawian participants. This had the potential to create dissention between US and Malawian team members since the change in rates only affects Malawian partners. The project's implementation team tried to manage expectations of participants by proactively and clearly communicating the changes to all participants in the project's activities; however the rate change resulted in lower turnout than expected at the AgESS conference and stakeholder workshop because the new rates were not enough to cover meals at the hotel and other travel expenses.

The project management team faced a number of logistical problems due to rising fuel costs and shortages, shifting calendars at each of the Malawian partner universities, and challenging procurement systems. The fuel shortages impacted the ability of program coordinators to carry out activities in a timely way because they had challenges in finding reliable transportation. This affected the ability of coordinators and team members to travel between the two universities as well as the ability of participants to travel to take part in short courses. To address the problem, the project coordinators had to adjust fuel allowance standard rates in line with the university's increased rates and asked participants to car pool when possible. We then worked to reschedule some meetings and activities for when fuel was more available. The team also faced repeated changes in academic calendars throughout the course of the program due to strikes and closures. These changes meant that we had to remain flexible in terms of the timeframe for delivering activities. Additionally, the procurement procedures at Chancellor College are very complex and bureaucratic and caused delays in purchasing equipment, especially library equipment. Fortunately, the Chancellor College project coordinator and the librarian were able to negotiate the system and in the end the equipment was purchased and installed.

Finally, many of the challenges we encountered during the project's implementation were related to changes in the universities' structures and administrative leadership. One year into implementation, Bunda College split from the University of Malawi to become its own standalone university, Lilongwe University of Agriculture and Natural Resources. This caused delays in implementing some activities, as the leadership of the university and therefore the university's priorities changed. Moreover, there was also leadership change within the University of Malawi. This specifically affected the implementation of our planned public-private advisory committee. The UNIMA Pro Vice-Chancellor, who was also the project's Malawian PI, unexpectedly left the university and took a post elsewhere. He was overseeing the implementation of the public-private (external stakeholder) activities. This has delayed the implementation of several activities related to public-private partnerships with the Malawi partner universities and caused slight delays in other activities because we needed to transition to a

different PI for the project. The Malawian project coordinators took on the responsibilities for the PI, and to address the issue of stakeholder engagement, we planned a stakeholder workshop with cooperation of administrators from the two universities to build public-private relationships with the university.

Conclusion

Key Lessons Learned

First, the importance of flexibility is a major lesson that the project management team learned through the implementation of this project. As noted in the implementation challenges section above, we came across several issues which forced us to change the timing for the delivery of several activities. A complex procurement system led to delays in purchasing library equipment, fuel prices and calendar shift caused us to reconsider when to offer particular trainings, and the project's Malawian PI and UNIMA Pro-Vice Chancellor leaving the university affected our delivery of certain stakeholder activities. In the end all project objectives were met, but this is due to the diligence and flexibility of the project management team. We were able to navigate a complex landscape to deliver a quality program.

Second, transparency in decision-making and budgeting contributed to the success of the project. It was important for the entire management team, Malawian and US, to have all budget information and to participate in the decision-making processes throughout the project planning and implementation. This contributed to a sense of joint ownership over the project and its outcomes and will likely contribute to sustainability not only of the project's outcomes, but also of a collaborative relationship amongst MSU, UNIMA, LUANAR, and LU. Along these lines, it was also important that we used the same compensation, per diem, and transport rates for host country and US personnel. This contributed to building trust between partners and a sense of equality within the partnership. The only challenge to this was the change in USAID/Malawi rates for host country participants' per diem and transport. With this new regulation, we were no longer able to provide equal rates to US and Malawian participants, and this change did have an impact on our partnership.

Finally, integration of project objectives into all of the project activities added to its success. While activities were organized under particular objectives, we were able to find ways to integrate other objectives into the design of the activities to better contribute to the overall goal of the project. Our four cross-cutting guiding principles helped us to do this in an intentional way. For instance, through the AgESS short courses, we contributed to building capacity in research, teaching, and engagement with external stakeholders. We also contributed to building awareness of gender issues and the importance of interdisciplinarity. In this way, each activity contributed as much as possible to the project's overall success and reinforced other project activities.

Effect on Policies and Practices in US and Host Country Institutions

As in other sections of this report, the project's effect on host-country policies and practices can be framed in the project's guiding principles. Related to institutionalized linkages with external stakeholders, the project was successful in building bridges between the university and the public, private, and NGO sectors. This occurred through the short courses where participants from the government, private sector and NGOs worked alongside university researchers to explore potential solutions to development problems in AgESS areas. Additionally, the seed grants included participants from the external sector, thereby creating an opportunity for researchers to connect with colleagues outside the universities. Finally, the fundraising workshop, stakeholder meeting, and research planning workshop forged a new way for the university to build sustainable relationships with external stakeholders to improve the relevance of teaching and enhance communication among researchers,

practitioners, and policymakers. The outcome of the final stakeholder workshop was to produce a report with recommendations for university administrators to act upon to maintain the linkages between the public and private sectors that developed through this project.

Another major impact on the host-country institutions relates to gender inclusivity and support for women. Several recipients of the project's women's scholarship were on the verge of dropping out of the university due to dire financial situations and family obligations. The scholarship supported them through their final years, many of them graduated, and they were encouraged to continue in the field due to the support they received. Moreover, outcomes of the research studies carried out under this project caused university administrators and faculty members to regard gender-inclusiveness not just in terms of access, but also in terms of the institutional environment for women. Both universities are currently working on policy changes that will address gender concerns. One example is the mentoring program at LUANAR, which is reshaping how the university will approach undergraduate student mentoring. The new program will now take into account the full range of student needs—academic and personal—and will take a gender-sensitive approach.

Finally, at MSU, faculty members have had the opportunity to internationalize their research through collaborative projects and engagement with Malawian colleagues. Many of them plan to continue the work in Malawi that they started through this project. Additionally, the MSU project management team gained significant insight into financial management practices at the host country institution and adopted better policies and practices to negotiate the financial relationship between MSU and the Malawian universities.

Continued Collaboration and Prospects for Sustainability

The collaboration between MSU and partners at UNIMA and LUANAR will continue far beyond the life of the project. MSU has maintained a nearly 30-year-long relationship with these institutions and several opportunities for future engagement are already planned. There are several ongoing grant projects between individual faculty members, and MSU's Global Center for Food Systems Innovation has selected LUANAR as one of their hubs and just launched their initiative. Many members of the AgESS project team are also collaborating with Malawian colleagues to produce an edited book which examines AgESS issues. This book will capture much of the research that was conducted under the AgESS project and will lay out an agenda for future research activities. There is no doubt that MSU will continue to support the strategic partnership with UNIMA and LUANAR that was formally established in 2008. MSU is dedicated to expanding work with Malawian institutions and Malawian institutions have expressed their commitment to engage with MSU.

Appendix B: Partnership Success Stories

1. **Impacting the Success of Disadvantaged Women Undergraduate Students in Malawi: Tenacity Rewarded:**

The story of Stiveria Ndala represents the challenges that disadvantaged women who are undergraduate students encounter in their academic life in Malawi, as well as the successes that can be achieved with even a small amount of extra support. Struggling through university studies with little to no financial resources, living in cramped and crowded conditions, and working to support not only themselves, but often children and other family members, disadvantaged students, especially women, understandably have a difficult time concentrating on their studies. This often leads to poor academic performance and, more often than not, dropping out of university. But, as Stiveria's case indicates, the scholarships for these women that are provided through the USAID-funded Agro-Ecosystem Services University Capacity Building project can have a measurable impact in these students' lives and on their academic success.

Stiveria Ndala joined Bunda College of Agriculture to pursue a Diploma/Degree program in Agriculture in the 1990s. Struggling to complete her studies and support herself, she left the university with only a Diploma after three years of study and went out to seek employment. While working at an NGO, Stiveria had children and added the responsibility of being a mother and bread winner for her family. In 2010, Stiveria again applied to a Degree Program at Bunda College of Agriculture to continue her education. The NGO released her but without any support for fees, living expenses and accommodation.

Although she did not have financial support, Stiveria decided to use her own funds that she had saved to pay for her tuition fees, which were about $1,200 per year. In addition to her tuition, Stiveria had to pay for her own accommodation and buy her own meals. The program was to take three years to complete; however, the savings were only able to support her for one year. In the second year, Stiveria generated funds for tuition and other necessities by selling second-hand clothes and other items. Sometimes she could not report to school in time because she was busy selling clothes during the holidays. There are times Stiveria would go to the Dean of Students at Bunda College and beg for financial assistance but the Dean does not have funds or scholarships to offer. In the final year of her studies, Stiveria decided to withdraw because she could not support herself any longer.

Before she could withdraw, however, she was informed by the Dean of Students about a scholarship opportunity for female students that were being offered through the USAID-funded Agro-Ecosystem Services Project at Bunda College. Stiveria was encouraged to apply, and fortunately, she was one of the students who successfully wrote essays for the competition. The essay demonstrated the struggles Stiveria had in her life as a student and as a mother as well as a breadwinner for her family. The project paid all the fees ($1,200) for the final year and provided a book allowance and extra funds for research.

Although the financial support from the project did not provide for her family, it was enough to change Stiveria's face from a sad one to an ever-smiling one. She concentrated her effort on classes. At the time Stiveria began receiving the project's support she had a GPA of 3.40 in her third year. She quickly

increased her GPA to 3.56 and she finished with a GPA 3.60. She graduated in December 2012 with grades that, according to LUANAR's grading system, are exceptional. While the scholarship provided by the Agro-Ecosystem Services Capacity-Building project was a relatively small amount of money, through the success and retention of students like Stiveria, it will have a long-lasting impact on both the individual students' future economic and professional success, and increase the number of qualified women candidates entering Malawi's workforce in crucial science-based areas.

2. New avenues to the future through a scholarship program: Masaka's Story

Ennipher Masaka's story is an example of how a relatively small amount of support for a motivated and bright student can have a big impact. She graduated with Bachelor of Education Humanities in November 2013 after a difficult, but ultimately very successful journey through her academic program. She was selected to receive a scholarship through the USAID-funded Agro-Ecosystem Services (AgESS) program to support her last two years at Chancellor College. These scholarships were part of the project's objective to address the challenges that disadvantaged women face in the university. A large focus of the project is to enhance gender diversity within the partner universities. More women than men leave the university before completing their degrees for a number of reasons. Most often, issues of family and finances play a major role in women's decisions to drop out. The scholarship program aimed to help alleviate the financial burdens many women students face so that they can focus on their studies and graduate.

Ennipher had been on the verge of leaving the university, but with this scholarship she was able to complete her program and graduate. Upon graduating, she has goals of making an impact in agro-ecosystem related education in Malawi. Ennipher comes from a rural area and grew up in a destitute female-headed household, having lost her father at an early age. Her first trip to a city was when she came to Zomba to apply for entry into the University of Malawi. For her first two years she was supported by local families. She also received funding from the Soko Fund and won another partial scholarship through an essay writing competition. For her third year, she was unsure of her funding situation and contemplated leaving the university. The Chancellor College Dean of Students identified her as a very good candidate for the AgESS women's scholarship program.

With this scholarship, Ennipher was able to stay in school, complete her degree, and gain new avenues to future employment. A modest input by this USAID-funded project through the women's scholarship program will make a long-term contribution to these women's future success. It will also have a broader impact on increasing the number of qualified women entering Malawi's workforce in crucial science-based areas.

3. Participatory Action Research in Malawi: Increasing Capacity for Problem-Solving and Community Engagement in Agro-Ecosystem Services

A group of researchers from several sectors in Malawi stand in a field listening intently and asking questions as a Malawian farmer describes his intercropping techniques and the research he has conducted in conjunction with university researchers and extension agents to test different farming approaches. This was part of a capacity-building short course offered at Lilongwe University of Agriculture and Natural Resources (LUANAR) in January 2014 on Participatory Action Research. The course was part of a larger USAID capacity-building project called "Agro-Ecosystem Services: Linking Science to Action in the region" being implemented by a partnership amongst LUANAR, University of Malawi-Chancellor College, Michigan State University, and Lincoln University, Pennsylvania.

Participatory Action Research (PAR), also known as participatory research and extension, is one of the farmer-led approaches that enables researchers, community members (in this case farmers), and development practitioners to work together. The idea behind PAR is that if farmers participate in research, a clearer understanding of plants, plots, fields, landscapes, people, families, communities, organizations, etc. and their interactions will emerge. This approach has the potential to improve testing, adaptation, and adoption of innovative agricultural practices that are suitable to local contexts. It is aimed at promoting farmer ownership and farmer-to-farmer diffusion of innovations.

Forty-three participants from the two Malawian partner universities, local NGOs, private industry, and the government sector attended this five-day short course taught by experts from the four implementing partner universities. Participants learned how PAR works and how to implement it. The course gave them hands-on experience in PAR, examining its strengths and weaknesses. The interactive approach included field experiences and group research that made a big impression with the participants. One participant noted that the course was especially useful for "…understanding PAR because I have just been reading about it in the literature without real hands-on experience with it." Another noted that he would most definitely use the skills taught in the course in his work: "I am writing a proposal and I think I shall use this methodology."

Participants found especially exciting and interesting the merging of social and natural sciences. One stated, "I have a natural scientist's background but the problems faced by communities are both social and concerning natural science, so I will utilize the skills and information acquired to fill the gaps which exist between natural and social scientists." Another noted the importance of community participation, "PAR is a tool that helps the exchange of ideas and knowledge in recognition that both researchers and farmers have something to learn from each other". Finally, a participant noted that PAR is relevant not only for university researchers, but can apply to all sectors. "The participatory action research cycle…is innovative and needs to be used even for NGOs."

It is clear from participants' assessments that the course has had a major impact on their work both in terms of research and a new approach to agricultural extension. It has encouraged many to adopt an approach that works with communities to develop locally generated and relevant solutions to food security and other development challenges.

Appendix C: Descriptions and Syllabi of AgESS-related modules and semester long courses

Payment for Ecosystem Services Module

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Submitted to: The Faculty of Development Studies
Lilongwe University of Agriculture and Natural Resources

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Topic 1: **Introduction for ecosystem service**
Learning Goals:

a. *Familiarize students with central themes of the course*
b. *Define and explain the concepts of ecosystem services and emerging markets and payments theoretical terms*
c. *Understanding the types of ecosystem services*

Class Period 1: Introduction to the Course
I. Learning Objectives:

- Define what ecosystems are
- Summarize types, examples and importance of ecosystem services.
- Explain threats associated to Ecosystems
- Discussing what can be done to reduce threats to Ecosystems

What are ecosystems?

Have you ever heard the word ecosystem being used and wondered what it means?
This term ecosystem is used to describe a specific combination of plant, animal and micro-organism communities and how they are linked and connected to their non-living environment. Would you be able to explain what a community is in terms of the environment? Before proceeding, take a pen and a sheet of paper and write two sentences to explain what is meant by the term community.

A community is a group of different populations living and interacting with the non-living environment in a specific place or location. Populations simply refer to groups of organisms or species that are same or similar to each other, and who can reproduce resulting in fertile (capable of producing young) offspring.

Do you see the difference?

Given that we've talked about what is an ecosystem, can you list some examples of ecosystems. Here are a few examples of types of land and aquatic ecosystems: savannas, rainforests, freshwater ponds, the Atlantic Ocean, and deserts.

Terrestrial or land ecosystems are called land biomes. There are many types of biomes in the world. These include:

a) Tropical rainforest, tropical dry forest, tropical savanna, desert, temperate grassland, temperate woodland, temperate shrub land, temperate forest, boreal forests, north western coniferous forests, and tundra.

b) Aquatic or water ecosystems are divided into three main categories. These are freshwater, brackish and marine. These three groups are then further divided into subgroups.
c) Freshwater ecosystems can be placed into the following groups based on the flow of water. Flowing water ecosystems include our rivers, and creeks that flow over the land, while standing water ecosystems include our lakes, and ponds. Another group of freshwater ecosystems are wetlands. We will talk more about wetlands in

What are ecosystem services?

Ecosystem services refer to those processes by which the environment produces and provide resources that support and maintain the aesthetic value of the environment, while supporting the livelihood of both humans and biodiversity.

In other words, ecosystems usually provide services that help to maintain the environment, supporting the different life forms that depend on each other.

Some general services provided by the environment and its resources are:

- seed dispersal (scattering)
- mitigating (reducing) drought and floods
- protecting people from the sun's harmful ultraviolet rays
- cycling and moving nutrients
- protecting stream and river channels and coastal shores from erosion
- detoxifying and decomposing wastes
- controlling agricultural pests
- maintaining biodiversity
- generating and preserving soils and renewing their fertility-
- contributing to climate stability
- purifying air and water
- regulating disease carrying organisms
- pollinating crops and natural vegetation
- supporting and maintaining the livelihood of the people

The ecosystem services which are especially important are:-

- Pollination
- Pest Control
- Climate regulation
- Carbon sequestration
- Watershed protection
- Flood and erosion control
- Biodiversity

Ecosystem Services provided by the Tropical Rain Forest include:-

- Carbon Sequestration - taking carbon as carbon dioxide out of the atmosphere and storing in plants
- Air purification – absorbing and storing polluted air, storing and filtering and then releasing back into the atmosphere as clean air that helps to support the continued survival and growth of organisms. We will talk a bit more about carbon sequestration in Lesson 4.
- Maintenance of a wealth of biodiversity that is rich and healthy and ranges from animals, plants, insects, fungi and bacteria that all help to safeguard and maintain ecosystem function and the aesthetics of the environment.
- The roots of the trees holds the soil together, hence protecting the soil against erosion
- The support and maintenance of the pollination of different species of plants

- Aiding in the dispersal of seeds, either by wind, water or animals
- Continued recycling and production of nutrients through the action of microorganisms, hence maintaining the nutrient level of the soil that helps to support growth of plants.
- Protecting the watershed of an area, marsh, swamp, creek, rivers and lakes.

Threats to Ecosystems

Ecosystems throughout the world are facing many threats, as the human population grows and as the world continues to change. These threats to ecosystems that will then impact the services they provide include:-

- Massive agriculture activity – use of excessive pesticides, fertilizers and animal waste that are leached into nearby environments / water bodies, affecting the biodiversity population on land and water Pollution of land mass, though, irresponsible mining, forestry and other human activities.
- Chemicals that are deposited from these activities will have severe impacts on some fragile ecosystems and its component parts, such as animals, plants and other living organisms. It can also have impacts on the social wellbeing of the people who rely on these resources. During the human activities, huge amounts of carbon is also burnt and emitted into the atmosphere thus polluting the air.
- Introduction of non-native species from one area into an area that is totally different to its initial habitat, bringing with it certain pests and diseases that are introduced into a new environment, resulting in harmful effect on the native species.
- Over-harvesting of fish with the use of gill nets, and poisoning of creeks and ponds that can worsen the water pollution, that will lead to the decline of the fish population within an area.
- Deforestation from clear cutting of the forest, exposing the top soil to excessive erosion by wind or water.
- Erosion of soil from massive ill-conceived agriculture, overgrazing, mining and forestry. This result from irresponsible and unguided approaches by legislation and adequate working ethics for the environment.

What can we do to reduce the threats?

Changes in priorities and active and adaptive management will be needed to maintain biodiversity and ecosystem services under a changing climate. There is a need for active management, involvement of local people in the decision making process and active participation in formulating management strategies, that will take the form of further improving protection from human interference. In all cases, biodiversity and ecosystem values must be actively considered - in the face of climate change and in the context of competing uses for land for the purpose of forestry, agriculture, mining, fishing, hunting and use of plants for medicinal purposes.

This requires an on-going process in public awareness to anticipate how ecosystems will respond to a changing climate while interacting with other environmental parameters. Some species will die out, others will persist, and some will migrate, forming new combinations of species. The ability to fully accept such change will always be incomplete and far from perfect if this approach is not treated in a participatory manner.

Therefore, any management actions must be within a framework that includes local community-based organizations and national decision makers and must be flexible and adaptive. This must take the bottom up approach. Some simple approaches include:

- Biodiversity Planning and Management - A plan for actively managing the viability of ecosystem services as the climate changes should be developed for all conservation lands, village lands, waters and significant areas of habitat. Some fundamental elements of the planning process should include: Climate-smart management plans for coping with major stressors, such as fire, pests, and nutrient loads.
- Decision procedures and triggers for changing management priorities in the face of climate change. For example, if a conservation area is affected by two fires within a short period, making the reestablishment of the previous habitat and values unlikely, then a programme to actively manage the transition to an alternative ecosystem structure should be implemented. Integration into the plans of the rights, interests, and contributions of indigenous peoples and others directly dependent on these lands or waters.
- Payment for Ecosystem Services - A significant opportunity for additional payments for conservation and improved land management may flow from the scheme for Reduced Emissions from Deforestation and Forest Degradation (REDD) under consideration by the United Nations Framework Convention on Climate Change (UNFCCC). REDD seeks to lower emissions by paying countries for reducing deforestation and degradation.
- Ecosystem-based adaptation - "Hard" adaptation measures such as coastal defence walls, river embankments, and dams to control river flows all present threats to biodiversity.
- Adaptation goals can often be achieved through better management of ecosystems rather than through physical and engineering interventions; for example, coastal ecosystems can be more effective as buffer zones against storm surges than sea walls.
- Other options include catchment and flood plain management to adjust downstream water flows and the introduction of climate-resilient agroforestry activities.
- Ecosystem-based adaptation will aim to increase the resilience and reduce the vulnerability of people to climate change through the conservation, restoration, and management of ecosystems and dry-land pastoralism to support robust livelihoods

Class Period 2: Biodiversity, Threats to Biodiversity and Benefits from Ecosystems

I. Learning Objectives:

- Define Biodiversity
- Linking Biodiversity with Ecosystem Services
- Summarize Freshwater, wetland and carbon sequestration .

What is biodiversity?

Biodiversity is a term that combines two words; biological and diversity. Do you know the meaning of these two words? If you do, then it is no secret to you what the term biodiversity refers to! First, the word biological is from the Greek word bios and refers to living things, while diversity means the many different and various forms of.

You read about what the term biodiversity means, and what are some examples of biodiversity? Do you think biodiversity is important to us? Can you think of ways in which biodiversity helps us in our everyday life? Biodiversity is one of nature's most impressive gifts to us as humans. Many species (a group of similar animals or plants that can reproduce and produce fertile offspring) provide us with food, medicines, materials for clothing and for shelter, as well as other benefits that we cannot see, but we know exist.

Do you know how plants make their own food? Plants can manufacture their own food via a process called photosynthesis. In photosynthesis, plants use carbon dioxide from the air around us, water, chlorophyll (the green pigment in plants) and energy from the sun to make glucose (their food) and oxygen. Can you tell how plants help people when they undergo photosynthesis?

Study this equation of photosynthesis and highlight the parts that help us survive.
Water + Carbon dioxide = Glucose + Oxygen
When plants undergo photosynthesis they make glucose or food, which provides energy. In the environment around us, energy is transferred from one organism to another through feeding relationships that make up food chains and food webs.

The plant produces food which it stores in its leaves and roots using the process of photosynthesis. The cow then eats or consumes the plant (grass), and gets energy which allows it to grow. When the rancher catches and kills the cow – he gets beef, which he then sells to Rachel's parents. When the beef is prepared, Rachel then consumes it as part of her meal, from which she gets proteins that allows her to grow. This is a simple example of a food chain. In real life, food chains are much more complex and are referred to as food webs.

Plants use carbon dioxide (CO_2) in the process of photosynthesis – and produce oxygen (O_2) as a bi-product. Which of these two gases is important for our respiration? Oxygen is: we breathe in oxygen, which is necessary for us to live.

These are just two ways in which biodiversity helps us. Can you think of others?
Biodiversity perform important functions in the ecosystem; in the processes of soil formation, water and air purification, nutrient cycling, the absorption of solar energy, and in many other important processes which occur in nature.

Threats to biodiversity

a) **The changing and destruction of habitats** – There are times when the activities that we do can destroy natural habitats. When these habitats or homes of plants and animals are destroyed, the species that lived in those places begin to vanish. Development is important, but we should ensure that our activities are carried out in a way that is not destructive to the natural environment. Research has shown that the greatest current losses of biodiversity occur in tropical moist forest. Can you imagine what would happen, if more than half of the world's biodiversity lives in the tropical rainforests of the world – and these forests are destroyed?

b) **Overusing** – This is probably the most obvious way in which we contribute to the loss of biodiversity. Sometimes in our quest for survival, we become overly zealous in our gathering and sourcing of the materials necessary for our survival; whether it is for food, for raw materials for the development of medicines, clothing, shelter and/or other uses. Many plants and animals have become endangered and extinct because of our unregulated use of them. In some cases, we take more than we need from the environment and thereby reduce the population numbers in the wild, and in others we harvest plants and animals that have not yet reproduced and contributed to the growth of its population. With the continually growing human population and increasing need for cash economies, the world has seen a very high level of increase in the commercial extraction of species from the environment over the last five decades. In most cases the rate at which species are removed from the environment is much higher than the

reproductive rate of those species. Can you think of any plant or animal that you have observed less of in your village? Why do you think you are seeing less of this plant or animal?

c) **Pollution** - Humans are aware of the effects of toxic pollutants on local populations of plants and animals. There have been many documented cases of the effects of various pesticides that were used by people on populations of birds and fishes. Many of the chemical pollutants contain substances that affect the ability of plants and animals to protect themselves against diseases and other infections. Some pollutants that do not start out as pollutant, but because of the manner in which they are disposed of, posed serious threats to many populations of plants and animals. Can you think of any pollutant in your village that affects biodiversity within the area?

d) **Introducing new species into places where they did not exist previously** – The term used to describe organisms that are introduced into habitats or wild homes where they are not native is: exotics. The introduced species can be thought of as a form of biological pollutant. The deliberate or accidental introduction of exotic species from one habitat to another has affected the local or native populations. In the new habitat, an introduced species or exotic is able to grow and reproduce very fast, because the predators and competitors in its original habitat are not there to control their population. This rapid population growth of the introduced species in most cases results in the native or local populations of plants and animals being displaced.

e) **Natural Events** – The environment in which we live is always changing. These changes are sometimes large and sometimes small. There are natural events that occur that can also threaten the survival of biodiversity. These include thunderstorms, floods, drought, and other weather conditions that can severely impact the well-being of people.

Freshwater Resources
Concept: Freshwater as an important component for the survival of life on earth.

The role of water and the water cycle
Water is necessary for life and all living processes. Can you imagine living without water in any of its three forms (liquid, solid ice, gas water vapor). Water is responsible for the transporting and regulation of many substances and processes not only for us as humans but also in the environment around us. Oceans, rivers, lakes, ponds and other water bodies are said to cover more than 70% of the entire surface of the world. Can you believe that? Of that – can you guess how much of it is classified as freshwater –3% fresh water, 97% salt water, but guess what?

Have you ever wondered how it is that water gets recycled? There is a special process that occurs in the environment that some people call the hydrological or water cycle that is responsible for the recycling of water. The water cycle has 4 main processes.

1. Evaporation;
2. Condensation;
3. Precipitation; and
4. Collection.

Do you think you know what each of these processes refer to and how they work?

The sun has a very important role in this cycle. Water from rivers, oceans, creeks, ponds, and lakes is absorbed by the heat energy that is given off by the sun. The process in which water from the earth's

surface is absorbed from the heat of the sun is called evaporation. As the water is absorbed and mixes with gases in the atmosphere, it changes form – it becomes water vapor. This process is referred to as evaporation. As the heated air in the form of vapor cools – clouds are formed. This process is referred to as condensation.

Most of the water is returned to the water bodies by rain, dew, and other forms of precipitation. Water from rain is collected in rivers, creeks and ponds and may be harvested by people and stored in reservoirs. Trees and other vegetation cover help to protect the soil from erosion and increase the flow of water through soil to underground reservoirs. This process is called Collection.

The Wetland Ecosystem

Wetland ecosystems are very dynamic in nature and provide very important ecological and social services. These types of ecosystems are highly productive and are homes to very high and diverse groups of plants and animals. People also depend on wetlands for their livelihoods on a daily basis. According to the Ramsar Convention on Wetlands (1971), wetlands are defined as "areas of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which the low tide does not exceed six meters." Simply put wetlands can be used to refer to areas that are either permanently flooded or flooded only during certain times of the year. The wetlands are a very important source of freshwater not just for the people.

The Wetland is an area that includes both forest and savannahs' – which are intermittently flooded during the course of the year. This area covers a wide area of both forested and savannah regions. The Wetlands support many different types of habitats including savannah ponds, permanent ponds, rivers and creeks. These are different from each other in their own way but generally serve the same vital functions of providing food, shelter, breeding grounds and many other roles for many species of plants and animals, as well as food, income and recreation for people.

Clean air and carbon sequestration

Clean air is necessary for the survival of our planet, and finding a balance between the use and release of carbon into the atmosphere holds the key to clean air remaining in the atmosphere.

What is carbon, and what is the carbon cycle?

Carbon is a very important element. It is important for providing us with energy so that our human bodies can function and maintain itself. All living organisms convert glucose to energy. Can you guess what makes up glucose? Glucose is made up of carbon, hydrogen and oxygen that are bound together by special bonds. These bonds that carbon forms are key for the storage of carbon. Do you see how important carbon is to living organisms?

So carbon is found in all living organisms, but carbon can also be found in the air, the ocean and in some kinds (types) of rocks

The carbon cycle is the way in which this very important element circulates in the environment. In the carbon cycle, the gas carbon dioxide which is found in the atmosphere is the primary source of carbon. It enters ecosystems when plants photosynthesize and is captured in the bodies of living organisms. The carbon cycle has many different processes.

Carbon dioxide is released into the atmosphere by respiration (remember we breathe in oxygen and breathe out carbon dioxide), when volcanoes erupt, by animals and when we burn fossil fuels such as

gasoline and diesel. Plants take in the carbon dioxide from the atmosphere and use it to manufacture food in the form of carbohydrates. When other living organisms consume the plants, carbon is passed along. When these different organisms die, the bodies decompose and carbon is released back into the atmosphere.

Carbon may also be locked up for very long periods. Coal and oil that is found beneath the surface of the earth are the remains of plants and animals that lived millions of years ago. Their carbon atoms are not released until they are burnt. Additional large amounts of carbon can be found in oceans in the form of calcium carbonate which is what is found in the shells and skeletons of animals that live in the ocean.

To summarize: Carbon enters the atmosphere by respiration, by the burning of fossil fuels, and when volcanoes erupt. Carbon is removed from the atmosphere when plants take carbon dioxide in for photosynthesis in order to process and make food that is necessary for plant growth. This carbon is passed unto other organisms when they feed on the plants.

What is carbon sequestration?
Plants take in carbon dioxide, a gas, from the air in the process called photosynthesis. Remember in the carbon cycle the plant then breaks down the carbon dioxide, and stores the carbon in the tree, and releases the oxygen back into the atmosphere.

Do you think fast growing trees or slow growing trees are better to sequester or remove atmospheric carbon? Fast growing trees are, in fact, the most efficient way to sequester or remove atmospheric carbon.

Can you explain why this is so? Well, the faster the tree grows, the more food it will need – so it will have to photosynthesize much more than a slower growing tree, and therefore it will remove much more carbon from the atmosphere.

Carbon dioxide blocks radiation of heat from the surface of the earth, and keeps the heat in the atmosphere. More heat in the atmosphere has many effects – the climate gets warmer, plants and animals die from too much heat (and in turn release more carbon dioxide to the atmosphere), rivers and ponds dry up and so many other unfavorable events can happen. As such climate change can have severe and long lasting impact on the local people, since they are less likely to adapt to the changes, they are the most vulnerable group of people. Change in climate will affect crops, land, natural resources, and an upsurge in sickness that can pose a threat to their health. When gases like carbon dioxide trap heat in the earth's atmosphere – this is called the 'greenhouse effect'.

Class Period 3: Climate change and global warming
I. Learning Objectives:

- Explaining what Climate Change mean
- Discussing the changing climate and its impacts
- Summarize what can be done to combat Climate Change.

What does the term Climate Change mean?
Climate Change may be defined as "any significant change in measures of climate (such as temperature, precipitation, or wind) lasting for an extended period (decades or longer)

What is Global Warming?

Global warming refers to the warming that can occur as a result of increased emissions of greenhouse gases from human activities

Climate change has occurred as a result of irresponsible and a lack of consideration for the environment, such as burning of fossil fuel from vehicles, airplanes and industries and to some natural disasters, e.g. Volcanoes that erupt and send poisonous gases into the air that combines with other carbon dioxide that already exist in the atmosphere.

Impacts of Climate change - Climate change will affect all aspects of human life…globally.
Increasing global temperature and extreme changes in weather patterns have contributed to severe environmental impacts and caused havoc to many lives. Some examples of climate change impacts are:

- Rising sea level that contributes to flooding of vulnerable areas such as those below sea level e.g., coastal areas of Guyana
- Extreme weather changes, such as hotter days and nights causing discomfort to the social well-being of people
- Melting of icebergs at the Poles as a result of increasing temperature. There are already fewer icebergs in some areas as a result of melting due to increased temperatures or have already diminished, Changes in rainfall patterns from the normal pattern.
- Changes in the people's lifestyle, impacting the livelihood and communities of people.
- Increased vulnerability to natural disasters, e.g. landslides, hurricanes, especially in coastal areas.
- Increase spread of disease as warmer weather changes habitat and life cycle of pest and other disease vectors such as the malaria and dengue fever mosquitoes.
- Changes in the availability of food and fresh water.
- Impacts on agriculture – decreases in crop yield and production level.
- Displacement of human settlements
- Impacts on human health – skin cancer, respiratory problems, heat strokes by older folk as well as young people, eye problems, and other related ailments.
- Impacts on ecosystems and biodiversity – migration of animals and changes in the behavioral pattern of some species. Movement of species can contribute to the extinction of some species and the introduction of new species into some areas. Animals move from one place to the next for survival and also to acquire available food, due to loss of habitat
- Impacts on water supplies – Changes in regional rainfall and changes in water supplies will significantly affect agricultural production.

What can be done to combat Climate Change?
Solution is in our hands.

- Walk short distances
- Stop using water unnecessarily
- Controlled savannah burning
- Public awareness
- Support the Low Carbon Development Strategy (LCDS)

How do we address Climate Change?
1. Mitigation – reducing or stopping climate change by reducing the rate of greenhouse gas emissions
Urgent action is needed to address climate change and to reduce the emission of greenhouse gases into the atmosphere. Some actions are:

- Improve management of agricultural lands
- Use renewable energy (solar, wind, hydropower)
- Conserve and protect forested land
- Reducing deforestation is one of the most cost-effective and practical solution to addressing climate change
- Guyana can make a difference by being part of the solution by putting up its forest for climate change, through the LCDS
- Guyana's forest is our greatest asset, therefore conserving and protecting will help in the fight against climate change and help improve livelihood of local communities.
- Payment/compensation for ecosystem services

2. Adaptation – helping natural and human communities to adjust to the climate change that is already occurring.

- Strengthening our infrastructure (e.g. road and sea defense), to make them more resistant to extreme weather
- Helping farmers to adjust to new climatic condition through training, development of new crop varieties and improving new farming practices.

Global Strategies for dealing with climate change

The international organizations that lead international policy making with regards to the environment is the United Nations which includes 192 countries, where almost every country in the world is involved. The United Nations helps countries work together on many issues, including climate change.

Some of the Policies under the UN mandate are:

- United Nations Framework Convention on Climate Change (UNFCCC) which is designed to assist countries formulates climate change policies. Within the UNFCCC, a country comes together to work towards an agreement on mitigation and adaptation actions.
- The most recent agreement made by the UNFCCC is the Kyoto Protocol.
- However, the Kyoto Protocol comes to an end by year 2012, as such countries are working to develop new agreements, these discussions and negotiations are happening now. Part of the discussion forum sought to address the following areas;
  - Stop deforestation
  - Improve forest management
  - Improve crop and livestock production
  - Create national adaptation plans.

Topic 2: **Payment to ecosystem service**

Learning Goals:

a) Define and explain the concepts of ecosystem services and emerging markets and payments theoretical terms

b) Understanding the types of ecosystem services and emerging markets and their associated importance in various forms

c) Apply theories of ecosystem services and emerging markets and payments to an African/Malawian context.

Class Period 1: Payment to Ecosystems

I. Learning Objectives:

- Familiarize students with the definition of Ecosystem Services
- Summarize concepts and importance of ecosystem services.

Defining Ecosystem Services and the Concept of 'Payments'

Ecosystems are the combined interactions of Biological / living (plant, animal and micro-organism communities) components of environment and Physical / non-living components (air, water, soil and the basic elements and compounds of the environment). Examples: Coral reefs, Forests, Deserts, Tundra, etc.

Payments for Ecosystem Services

- PES includes both monetary and non-monetary transactions. Some PES transactions provide other forms of compensation for ecosystem services, such as strengthened property rights or temporary permission to actively manage the ecosystem involved.
- The key characteristic of these PES deals is that the focus is on maintaining a flow of a specified service such as clean water, biodiversity habitat, or carbon sequestration capabilities in exchange for something of economic value.
- The critical, defining factor of what constitutes a PES transaction, however, is not just that money changes hands and an environmental service is either delivered or maintained. Rather, the key is that the payment causes the benefit to occur where it would not have otherwise. That is, the service is "additional" to the business as usual scenario, or at the very least, the service can be quantified and tied to the payment.

A payment for environmental services scheme is:

- ✓ a voluntary transaction in which
- ✓ a well-defined environmental service (ES), or a form of land use likely to secure that service is bought by at least one ES buyer from a minimum of one ES provider if and only if the provider continues to supply that service (conditionality).

- Payments for Ecosystem Services (PES) are a way to incentivize land users to properly manage and conserve their natural environment – thus ensuring the flow of ecosystem services
- These schemes compensate those who provide ecosystem services through direct payments, selling credits for carbon, biodiversity or water on international or national markets, or through other similar mechanisms.
- Payments for Ecosystem Services (PES) deals are emerging wherever businesses, public-sector agencies, and nonprofit organizations have taken an active interest in addressing particular environmental issues. These schemes provide a new source of income for land management, restoration, conservation, and sustainable use activities, and thus have significant potential to promote sustainable ecosystem management.

Examples of the Ecosystem Services

Provisioning: Goods or products produced by ecosystems

- Food
- Fiber
- Genetic Resources
- Bio chemicals
- Fresh Water

Cultural Services: Non-material benefits obtained from ecosystems

- Spiritual and religious values
- Aesthetic values
- Recreation and ecotourism

Regulating Services: Natural processes regulated by ecosystems

- Air quality regulation
- Climate regulation
- Water regulation
- Erosion regulation
- Water purification
- Waste treatment
- Disease regulation
- Pest regulation
- Pollination
- Natural hazard regulation

Supporting Services: Functions that maintain all other services

Class Period 2: Ecosystem Services and the Economy and why 'Payments' for Ecosystem Services?

I. Learning Objectives:

- Familiarize students with Ecosystem Services and its contribution to the economy
- Summarize why 'Payments' for Ecosystem Services are needed.

Why 'Payments' for Ecosystem Services?

- Nature provides services free of charge
- Consumption of ecosystem goods (such as timber or oil) is favored over the conservation of ecosystem services
- Market forces must be realigned to invest in the production of both ecosystem goods and services
- If market forces reward investments in ecosystem services, a positive feedback loop will start in which increased investments in ecosystem services leads to increased production of ecosystem goods.
- This will fuel sustainable economic growth and ecological restoration

Ecosystem Services and the Economy

- Ecosystems provide society with a wide range of services from reliable flows of clean water to productive soil and carbon sequestration. People, companies, and societies rely on these services for raw material inputs, production processes, and climate stability.
- Ecosystem services fall into 4 categories
- The ecosystem services categories include: environmental goods (which we are accustomed to considering), regulating services (upon which we rely for a relatively narrow band of 'unpredictability' in weather, water flow, etc.), supporting services (which are key to produce environmental goods), and cultural services (which are enshrined in numerous public agency's missions and operating procedures).

Class Period 3: Drivers of Today's Challenges and Evolving Environmental Expectations

I. Learning Objectives:

- Familiarize students with drivers of today's challenges
- Summarize the evolving environmental expectations from ecosystem services.

Drivers of Today's Challenges

There is a growing global awareness of the services that natural ecosystems provide. Still, the value of these ecosystem services and the long term costs of their loss are rarely taken into account in decisions about how natural resources are used, or into calculating their 'cost'. Because these day-to-day management decisions often focus only on short-term financial returns, the ecosystems that provide these services are often degraded, sometimes in ways that irreparably reduce ecosystem service production.

- more than 60% of the world's ecosystems are being used in ways that cannot be sustained
- many of these ecosystem services are either undervalued or have no financial value at all
- as the global population swells by approximately 146 people every minute, the human strain on terrestrial, marine and freshwater ecosystems is causing some of nature's life support services to falter

Examples of drivers

- Lack of conceptual frameworks/ data
- Lack of clarity on property rights
- Lack of investment incentives
- Perceptions of public sector responsibility for maintenance
- Promotion of activities that undercut environmental services
- 'Invisibility' of effects, as impacts are dispersed across time and geographies

Evolving Environmental Expectations

- There are increasing signals that a "game changing" paradigm shift in environmental thinking is underway with the potential to significantly expand stakeholder expectations.
- Environmental thinking is broadening—from discrete issue management to inclusion of how business impacts may be affecting landscape-level ecological dynamics, such as the flows of ecosystem services.
- As expectations begin to shift, corporate leaders, landowners, and governments have begun to make commitments related to ecosystem services and develop new practices.
- Concurrently, there are emerging government actions, as well as expectations of activists, investors, consumers, and other stakeholders.
- Ecosystem services initiatives have been launched in relation to the International Standards Organization (ISO 14,001), the Global Reporting Initiative (GRI) and the Global Compact's Performance Model (GCPM).

Recognition of environmental protection policy failures

- Declining function of environmental services (60% degraded)
- Increasing demand for access to environmental services
- Growing license to operate challenges
- Human health linkages to environmental quality

Testing of alternatives

- Acid rain-related air pollutants
- Fisheries
- Wildlife hunting
- Waste quotas

Evolution of market-based incentives to environmental protection

Emerging focus on potential for market mechanisms designed to:

- Capture value through capping the use of and trading in markets focused on environmental services
- Discover prices based upon supply and demand
- Establish trading platforms

Topic 3:**Pro-Poor PES:** ***Opportunities, Risks, and Ideal Conditions of Ecosystem services.***

Class Period 1: Potential benefits of PES for the rural poor in the short-term

I. Learning Objectives:

a. Familiarize students with Potential benefits of PES for the rural poor in the short-term course
b. Understanding Opportunities, Risks, Ideal Conditions of Ecosystem Services

Potential benefits of PES for the rural poor in the short-term

- **Increased cash income** for consumption or investment purposes (such as increased caloric intake for children, expanded access to education and health care, new products for sale, improved enterprise productivity, etc.)
- **Expanded experience with external business activities** through PES-related economic transactions and interactions with PES-relevant intermediaries
- **Increased knowledge of sustainable resource use practices** through training and technical assistance associated with PES deal implementation

In the long-term:

- **Improved resilience of local ecosystems** and flow of ecosystem services
- Potential for **higher productivity land** due to ecosystem service investments
- **Potential Risks of PES for "Sellers" of Ecosystem Services**

Class Period 2: Potential risks of deals in Ecosystem Services

I. Learning Objectives:

a. Familiarize students with Potential risks of deals in Ecosystem Services
b. Understanding Opportunities, Risks, Ideal Conditions of Ecosystem Services

Potential risks of deals in Ecosystem Services

A range of potential risks exist for the rural poor in entering into PES deals. Therefore, careful consideration should be taken of the following:

- **Inadequate understanding of what is being bought and sold, and long-term implications for local livelihoods and resource rights.** The use of PES implies a market-based focus on relatively abstract ecosystem services, which may contrast with cultural conceptions and economic models operating within traditional communities. It is important to identify and consider these potential issues and "friction" points prior to actively exploring a PES deal.
- **Loss of rights to harvest products, or environmental services.** Prior to agreeing to a PES deal, it is essential to lay out a resource plan that accounts for sellers' access to forest resources — for food, fuel, non-timber forest products, medicines, and other items. This component is key to ensuring that the PES deal does not result in loss of rights to critical, non-negotiable activities for

prospective sellers and/or local communities. Consultations with all resource users on the land in question are essential in this process.

- **Other opportunity costs.** The possible loss of non-PES opportunities should be weighed against revenues from a PES deal. For example, if a community enters into a PES contract, donors and aid organizations may decide the community is less in need of their support. It is worth assessing whether any such potential opportunity costs are associated with a PES deal.
- **Loss of employment.** If a PES deal includes reduced land management activities, then it could reduce jobs.
- **Unfair outcomes.** There is a potential for unfair sharing of net revenues when rural communities form partnerships with business entities to supply ecosystem services, especially when there is asymmetric information on the demand market.
- **Increased competition for land, or loss of rights to land.** Success with PES could attract speculative investors, which could in turn squeeze out indigenous landowners, especially where low levels of tenure security exist.
- **Loss of critically important ecosystem services.** In designing a project, the needs of the entire ecosystem must be taken into account. Poorly-designed carbon sequestration projects, for example, could negatively impact both the watershed and biodiversity if they lead to large-scale monoculture plantations. Likewise, watershed service projects that measure success in terms of water flow may create incentives to divert water from the irrigation of local crops to downstream water delivery in a drought year, jeopardizing subsistence farmers.
- **Confusion over resource and ecosystem service rights.** PES schemes compensate people for taking action to maintain or enhance ecosystem services, but do not necessarily transfer resource rights. This distinction (and accompanying confusion) is particularly pronounced in hydrological / water related services payments, which do not entail transfer of water rights, per se. In the same way, biodiversity offsets payments would not necessarily imply accompanying control over biological or genetic resources. It is essential that agreements are clear on these distinctions.
- **Loss of control and flexibility over local development options and directions.** Poorly-designed easements or long-term contracts can limit land management activities to a narrow range of alternatives, which could cost community residents their rights to exercise certain options for managing their land. The limitations should be carefully scrutinized in light of potential future options that sellers of ecosystem services wish to keep open.
- **Performance risk and need for insurance.** Where payments are dependent upon delivery of specific ecosystem service outcomes, factors outside producers' control may result in failure to achieve contractual obligations and, subsequently, non-payment. For example, wildfires, insect infestations, or changes in rainfall could all affect forestry-based implementation activities. Therefore, it is ideal that all participants in PES schemes employ some type of insurance strategy, such as formal insurance or making sure that management activities cover a larger enough number of hectares to ensure the total number called for in the deal can be successfully included. Unfortunately, formal insurance policies are rarely used in tropical forestry, but new insurance products are being developed for large-scale companies (Cottle and Crosthwaite-Eyre 2002). The key of course will be the cost of these insurance policies and who bears the cost. If a buyer is willing to pay for insurance, that is — from a seller's stance — ideal. However, if that approach is not of interest to a buyer, then at least it is ideal to have risk sharing — between sellers and buyers — included in agreements so that not all risk is borne by sellers.
- **Incompatibility of PES with cultural values.** In some communities, PES is viewed as a commoditization of services that should not have a price tag attached. Critics are also concerned

that communities who are the custodians of those services or other poor "downstream" beneficiaries could themselves be made to pay for services as well.

Class Period 3: Example of Payment to Ecosystem Services.

I. Learning Objectives:

- Familiarize students with Example of Payment to Ecosystem Services
- Explain Carbon Sequestration and Capture
- Explain Watershed Protection Services
- Explain Soil Protection Services
- Explain Biodiversity Protection services

1. Carbon Sequestration and Capture

What?

To address key drivers of climate change, sellers might offer to provide, for a fee, services that help sequester carbon.

How?

- Preventing deforestation
- Reforesting land, particularly in tropical regions
- Reducing methane from farms, such as through manure management practices or changing the type of feed given to animals
- Implementing conservation tillage in agriculture to minimize release of carbon from the soil
- Avoiding actions that increase acidity of the ocean and release carbon.

Why?

- Keeping carbon dioxide in trees, oceans, and soil rather than releasing it into the atmosphere
- Increasing the uptake of carbon by trees and within forests
- Preventing:
  – release of methane to the atmosphere
  – increases in the atmospheric temperature
  – acidification and warming of the oceans

What to Measure?

In order to quantify carbon sequestration and storage through land use, land use change and forestry activities over time, there is a need to take inventories using carbon models employing a combination of on-site measurements and remote sensing.

Note that, although basic guidelines on forestry-based carbon sequestration in the tropics do exist, a need to tailor the work to the needs of specific site is important.

2. Watershed Protection Services

What?

To provide high-quality and reliable quantities of water in a watershed, sellers might offer to implement, for a fee, specific natural resource management practices or activities.

How?

Restoring, creating, or enhancing wetlands for the purpose of compensating for damage or destruction to another wetland area

- Maintaining forest cover
- Reforesting, possibly with a focus on specific (often native) tree species

- Adopting 'sustainable' or 'best' land use management practices, such as from sustainable farming or sustainable forestry

Why?

Actions would be selected to provide some, or all, of the following benefits:

- Creating or maintaining natural filters in the watershed to reduce water pollution
- Maintaining vegetation in order to aid in regulation of water flow through the year
- Controlling for floods
- Minimizing soil loss and sedimentation

How to Measure?

Water quality issues are perhaps the easiest components to measure, while other hydrological dynamics related to flow (quantity of water) are more difficult. While many watersheds lack sufficient data, it may be possible to learn from measurements and relationships from similar watersheds where such data is available.

3. Soil Protection Services

What?

To provide for healthy and intact soil, sellers might offer to undertake, for a fee, specific land and soil management activities.

How?

Using forest cover to minimize soil erosion and loss of nutrients

- Implementing sustainable and/or 'precision' agricultural techniques to prevent excess application of fertilizers and other nutrients
- Switching to alternative agricultural practices such as conservation tilling, or protection of natural waterways to prevent soil erosion and maintain soil health and overall fertility

Why?

- Avoiding loss of soil through runoff
- Maintaining healthy soils and minimizing need to apply fertilizers and pesticides
- Reducing soil salinity

How to Measure?

In measuring soil protection services, it is essential to consider erosion rates and current soil loss.

4. Biodiversity Protection

What?

To protect biodiversity, sellers might offer to protect species habitat or prevent a habitat from being fragmented in a way that undercuts the ability of the species to fully utilize it.

How?

Sellers might offer to provide, for a fee, activities such as:

- Establishing biological corridors between protected areas
- Creating new protected areas or strengthening ineffective protected areas
- Replanting degraded areas with native species and/or removing invasive alien species, as well as maintaining healthy soils and minimizing the need for fertilizers and pesticides
- Managing biodiversity to maintain quality agricultural products, ensure pest control, pollination, protecting genetic resources or general provision of key habitats
- Avoiding damage to areas of cultural, spiritual or aesthetic value
- Launching conservation projects outside of the project area

Why?

Maintaining biodiversity

How to Measure?

Due to the expansiveness and complexity of biodiversity, there is no single agreed upon way to measure it. Instead, biologists use many methodologies for assessing biodiversity across structural (type and amount of species) and functional (ecosystem services) levels. Two examples of current work on measuring biodiversity include:

Topic 4:**Steps to Developing a Payment for Ecosystem Services.**

Learning Objectives:

a. Familiarize students with A Step-by-Step Approach to Developing PES Deals
b. Understanding how to Identify Ecosystem Service Prospects & Potential Buyer.
c. Understanding Structuring Agreements

Preamble

Once all of the details associated with an ecosystem services agreement are clear and the buyer is interested, then the process of structuring an agreement begins.
Before entering into negotiation with a prospective buyer – and even before identifying support institutions and partners – a prospective seller or group of sellers should assess.

Class Period 1: Stages in developing PES Deals

I. Learning Objectives:

To familiarize students with Stages in developing PES Deals

Lecture outline

Step 1: Identifying Ecosystem Service Prospects & Potential Buyers

- Defining, measuring, and assessing the ecosystem services in a particular area
- Determining marketable value
- Identifying potential buyers who benefit from the service
- Considering whether to sell as individuals or as a group

Step 2: Assessing Institutional & Technical Capacity

- Assessing legal, policy, and land ownership context
- Examining existing rules for PES markets and deals
- Surveying available PES support services and organizations

Step 3: Structuring Agreements

- Designing management and business plans to provide the ecosystem service that is the focus of the PES deal
- Reducing transaction costs
- Reviewing options for payment types
- Establishing the equity and fairness criteria for evaluating payment options
- Selecting a contract type

Step 4: Implement PES Agreement

Key Actions

Implementation tasks may include (see list on slide with extended notes below)

- Hire people prepared and willing to take on particular roles and responsibilities
- Prepare accounting management and tracking systems for the project
- Open accounts to manage funds
- Train participating community members on the activities allowed on the land, including appropriate representation of community members—particularly women and low-income members—in the management of community-based PES deals, with clear roles

Class Period 2: negotiating PES deals and Key Issues by sellers

I. Learning Objectives:

To familiarize students with what can be done when negotiating PES deals and Key Issues by sellers

What can be done negotiating PES DEALS?

i. **Aggregate projects**

Streamline sales and negotiations among multiple process and funding mechanisms

ii. Build on existing programs

Diagnose local needs, priorities and PES opportunities

Strengthen community organization and local knowledge related to a PES project

iii. Bundle environmental service payments

Link to local or national water and/or conservation projects,

Develop multiple payments for different activities on the same piece of land.

iv. Create cost-sharing mechanisms

Specialized firms or agencies for community-based projects can solicit contribution from:

- national or state agencies
- overseas NGOs (developmental or environmental)
- private-sector companies
- municipal utilities
- local communities

v. Create specialized services from intermediary organizations

Specialized firms or agencies for community-based projects can

- provide technical expertise in project design,
- support central negotiations,
- establish mechanisms for financial transfer, and
- Verify PES actions.

vi. Establish intermediary management institutions

- Draw up and register farmers' plans related to PES,
- Assesses plans for ecosystem service contributions,
- Develop ecosystem service agreements between buyers and sellers,
- Provide technical assistance,
- Monitor project

vii. Reduce data costs

- Improve data and methods for project planning, baseline development and monitoring

viii. Establish large-scale, area-wide projects

- Develop project over entire jurisdiction, committing to defined increase in forest cover or area protected
- Partner with other small providers to share transaction costs of project development

ix. Set up a Trust Fund

- Serve as central repository of funds, decision making body, multiple stakeholder entity where conflicts can be resolved preemptively,

Key Issues by sellers

- In addition, ecosystem services sellers should be mindful of understanding answers to the following questions
- What costs may be incurred during implementation of the deal? Are these costs built into the agreement and/or the financial benefits that sellers will accrue?

- What are the projected revenues for sellers? When and how will these revenues be delivered?
- What, if any, intangible benefits will sellers realize (such as training, technical assistance, etc.)? Are these benefits sufficiently important to allow for a lower monetary reward?
- What are potential risks to sellers and pathways for mitigating risks?

How to reduce Costs

- While negotiating the agreement, both buyers and sellers may wish to explore ways in which to reduce costs
- At one extreme, and in cases where communities and land managers have little prior organizational expertise, start-up and transaction costs can absorb a significant portion of the seller's hoped for profit. This situation is why it is critical to estimate and review transaction costs throughout the process – a costly activity in its own right, and one made difficult by the fact that all costs will vary not only from project to project, but also throughout the lifecycle of many individual projects.

- If the costs are too great, the PES deal developers should explore ways of covering them, or even adjust or halt the process to address expenditures. In some cases, transaction costs may be so high that a PES deal is not possible in that area.

Class Period 3: Potential Roles for Honest Brokers of PES Deals and forms of payments

I. Learning Objective:

- To familiarize students with what potential roles for honest brokers of PES deals and forms of payments

Potential Roles for Honest Brokers of PES Deals

- Helping sellers assess an ecosystem service 'product' and its value to prospective buyers, through identifying and documenting:
  - what ecosystem services may be available to sell,
  - how much exists,
  - what the market context is (such as regulated or voluntary),
  - what business case exists for a company to invest in, and
  - What value the ecosystem service has and what market price has been paid (ideally based on comparative prices from the same area).
- Assisting sellers with establishing relationships and rapport with potential buyers, through:
  - developing a list of potential buyers,
  - setting up meetings between prospective sellers and buyers, and
  - facilitating meetings to ensure that expectations of both buyers and sellers are met.
- Enabling sellers get to know potential buyer(s) well, by ensuring that meetings reveal key details, such as:
  - prices paid for comparable payments for ecosystem services (and why these are the prices),
  - buyer's views on potential business benefits, and risks, of entering into agreements and making payments for ecosystem services, and
  - Challenges being faced by the company that may inform their interest and price sensitivity related to a purchase.
  - Assisting with proposal development, by:
  - quantifying ecosystem services to ensure appeal to buyers,

    - pricing of services,
    - addressing, and lessening as much as possible, transaction costs,
    - structuring agreement,
    - selecting a payment type that interests both seller and buyer
    - assessing various approaches to financing,
    - identifying and getting agreement on corporate point people, and
    - Keeping the discussions in motion.
- Ensuring that the final agreement is in sellers' best interest and providing risk management advice and services, as well as negotiating on behalf of the community.

Options of payment Types

- **Direct financial payments**, usually compensation for opportunity costs or loss of livelihood incurred by ecosystem service protection, such as the conversion of managed farmland to natural forest
- **Financial support for specific community goals**, such as building of a school or clinic to remunerate for ecosystem services
- **In-kind payments,** such as the beehive-for-conservation payment transaction
- **Recognition of rights,** such as increased land rights and increased participation in decision-making processes.
- **Pay per tree** Rewarding individual tree growers for carbon sequestered and capacity for future carbon sequestration on a per tree basis.
- **Pay for forest establishment or forest protection** Compensating community forest management organizations to protect or regenerate forest areas, or establish plantations. The community organization is then given financial benefits to distribute among members.
- **Enable more profitable and sustainable land management** Funding extension services, tree nurseries, marketing infrastructure, community-based forest enterprises, and other such support services for individual producers (or forest protectors) who will then gain financially by participating in new land-use activities or sharing income from forest protection.
- **Pay communities with improved services.** Providing services, such as health clinics, education, or enhanced rights to resources (land, forest, grass, and water) that improve household or community welfare.

Terms and types of payments

- **Terms and type of payment** specifying when, how much, how often, to whom, and other details, such as: cash to one person, to a community group, to a vendor of a community service (e.g., builders of a school) as well as whether the payment is in the form of cash, in-kind technical assistance, in-kind materials for building a community building, etc.
- **Timing of payments** in terms of when the ecosystem service activities are carried out by the seller, when the buyer ensures that monitoring of the action occurs, or a combination of both.
- **Requirements that need to be met for payment**, such as periodic monitoring, reporting and verification needs.
- **Managing risks,** particularly those beyond a seller's control (such as unexpected natural events) through specific clauses in agreements detailing how certain risks are shared between sellers and buyers, or even insurance (provided it is available, cost-effective and feasible
- **Signatories to the contract** should be directly affiliated with the buyer (or group of buyers) and the seller, though it may be useful to have provisions for specific roles of support institutions, as

well as details on the exact payment that will be made for services rendered by the intermediary.

Class Period 4: Contracts and Agreements

I. Learning Objective:

- To familiarize students Contracts and Agreements in PES

Contracts

- The agreement type can vary, it is only essential that all details be clearly laid out and understood by both parties
- It is possible to enter into both verbal and written contracts, each of which has its advantages and disadvantages. Written contracts can be costly and more time-consuming, but they leave little room for misunderstanding and they create a record which can be referenced at any time. Verbal contracts, however, can be misinterpreted by either party which damages the trust between buyer and seller. A simple contract written in the local language with the help of a local lawyer can be a low cost solution which allows both buyer and seller complete understanding of the transaction.
- It is critical to keep the agreements realistic; potential limitations must be well-understood.
- Long-term contracts should specify dates when the contract will be reviewed and potentially amended
- Contracts can include verification procedures to assess performance. Contracts can include a rating system that is the basis for increasing payments for outstanding performance and decreasing payments for underperformance.

Types of contracts

- Memorandum of Understanding or Memorandum of Agreement
- Legal contract
- Customary law agreements
- "Handshake" agreement
- Quid-pro-quo

PES agreements should clearly lay out:

- who will pay transaction costs as well as ongoing management and monitoring costs
- who is responsible for what actions
- what ecosystem service results are expected
- how results will be demonstrated and who will be responsible for monitoring, evaluating, verifying, and certifying them
- who will receive what amount of money in what specified time frame
- which criteria will be used to evaluate the fairness of the PES deal
- how risks (particularly around unexpected natural events) will be handled and even shared between buyers and sellers

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Topic 5:**Monitoring and Evaluation.**

Learning Objectives:

Familiarize students with Monitoring and Evaluation of PES

Monitoring and Evaluation

Monitoring and evaluation is key and should be undertaken in such a way that is agreed upon by both parties. Developing project management goals, objectives, and monitoring indicators should be 'SMART':

- Specific
- Measurable
- Agreed-Upon
- Realistic
- Time-Constrained

i. **Determination of who selects indicators and who is reporting to whom**
Selection of Indicators: *Indicators should be…*

- relevant to the PES project
- measurable
- respond to changes in the environment
- fit into the rest of the M&E scheme
- reliable

ii. Creation of a "Local Ecosystem Conceptual Process Model" that:

- outlines the cause-and-effect relationships that occur within the ecosystem
- identifies which specific characteristics of the ecosystem to monitor

iii. Selection of Monitoring Sites, the most commonly used practice being a "stratified random sampling" technique which can:

- reflect the overall distribution within the project area
- ensure that the monitoring sites are sufficiently spread out

M&E parameters might be able to also include *stakeholder concerns* such as:

- total project costs
- timeliness of financial disbursements
- performance of various support services or financial intermediaries
- protection of local ecosystem values
- equity in local distribution of PES project benefits
- specific household and community-level benefits

Finally, the M&E plan made at the outset of the project should also specify who will conduct the monitoring, how frequently and at which times, and using which methods, as well as who will pay for monitoring.

Overall, M&E activities will identify what is being accomplished and how project management can be improved. The M&E results should be made available to buyers, intermediary institutions and the public to increase transparency and legitimacy.

Glossary

Adaptation: Adjustment in natural or human systems to a new or changing environment. Adaptation to climate change refers to adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.

Biodiversity: The variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.

Carbon cycle: All carbon reservoirs (atmosphere, terrestrial biosphere, oceans, and sediments) and exchanges of carbon from reservoir to reservoir by various chemical, physical, geological, and biological processes.

Carbon dioxide: A colorless, odorless, non-poisonous gas that is a normal part of the ambient air. Carbon dioxide is a product of fossil fuel combustion. Although carbon dioxide does not directly impair human health, it is a greenhouse gas that traps terrestrial (i.e., infrared) radiation and contributes to the potential for global warming.

Carbon sequestration: The uptake and storage of carbon. Trees and plants, for example, absorb carbon dioxide, release the oxygen and store the carbon. Fossil fuels were at one time biomass and continue to store the carbon until burned.

Climate Change: Climate change refers to any significant change in measures of climate (such as temperature, precipitation, or wind) lasting for an extended period (decades or longer). Climate change may result from:

- natural factors, such as changes in the sun's intensity or slow changes in the Earth's orbit around the sun;
- natural processes within the climate system (e.g. changes in ocean circulation);
- human activities that change the atmosphere's composition (e.g. through burning fossil fuels) and the land surface (e.g. deforestation, urbanization, desertification)

Deforestation: Those practices or processes that result in the conversion of forested lands for non-forest uses. This is often cited as one of the major causes of the enhanced greenhouse effect for two reasons: 1) the burning or decomposition of the wood releases carbon dioxide; and 2) trees that once removed carbon dioxide from the atmosphere in the process of photosynthesis are no longer present.

Ecosystem: The complex system of plant, animal, fungal, and microorganism communities and their associated non-living environment interacting as an ecological unit.

Endangered species: A technical definition used for classification in the United States referring to a species that is in danger of extinction throughout all or a significant portion of its range. IUCN, the World Conservation Union (1994) definition, defines species as endangered if the factors causing their vulnerability or decline continue to operate.

Endemism: The occurrence of a species in a particular locality or region. Exotic species: An organism that exists in the Free State in an area but is not native to that area. Also refers to animals from outside the country in which they are held in captive or free-ranging populations.

Extinction: Disappearance of a taxonomic group of organisms from existence in all regions.

Fauna: Organisms of the animal kingdom.

Flora: Organisms of the plant kingdom

Global warming: The progressive gradual rise of the earth’s surface temperature thought to be caused by the greenhouse effect and responsible for changes in global climate patterns.

Greenhouse effect: Trapping and build-up of heat in the atmosphere (troposphere) near the earth's surface. Some of the heat flowing back toward space from the earth's surface is absorbed by water vapor, carbon dioxide, ozone, and several other gases in the atmosphere and then re-radiated back toward the earth's surface. If the atmospheric concentrations of these greenhouse gases rise, the average temperature of the lower atmosphere will gradually increase.

Greenhouse gas (GHG): Any gas that absorbs infrared radiation in the atmosphere. Greenhouse gases include, but are not limited to, water vapor, carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), hydrochlorofluorocarbons (HCFCs), ozone (O3), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF6).

Habitat: The environment in which an animal or plant lives, generally defined in terms of vegetation and physical features.

Photosynthesis: Complex process that takes place in living green plant cells. Radiant energy from the sun is used to combine carbon dioxide (CO2) and water (H2O) to produce oxygen (O2) and simple nutrient molecules, such as glucose (C6HI2O6).

Species: A group of organisms capable of interbreeding freely with each other but not with members of other species.

Trophic level: Position in the food chain, determined by the number of energy-transfer steps to that level.

Suggested Readings and Resources

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Association of Environmental and Resource Economists www.aere.org.

BBOP – Business and Biodiversity Offsets Programme http://www.forest-trends.org/biodiversityoffsetprogram/

The Beijer Institute of Ecological Economics http://www.beijer.kva.se/

Biodiversity Economics www.biodiversityeconomics.org

CIFOR's PES Website http://www.cifor.cgiar.org/pes/_ref/home/index.htm

CARBOFOR http://www.cifor.cgiar.org/carbofor

DEFRA http://www.defra.gov.uk/wildlife-countryside/natres/eco-actionp.htm

Eco agriculture Partners http://www.ecoagriculturepartners.org

Eco-agriculture Partners. http://esa.org/ecoservices/

Ecology and Society http://www.ecologyandsociety.org/.

The Ecosystem Marketplace http://ecosystemmarketplace.com

http://www.ecosystemservicesproject.org/ Initiated by CSIRO (Australia).

Ecosystem Valuation http://www.ecosystemvaluation.org/

EEPSEA - Economy and Environment Programme for Southeast Asia http://www.idrc.ca/eepsea/ev-115216-201-1-DO_TOPIC.html

Environmental economics blog http://www.env-econ.net/

Environmental Valuation Reference Inventory http://www.evri.ca/francais/Resources/S_Services.cfm?Section=%20passive%20uses#list

A HUGE collection of references to valuation documentsEuropean Environmental Agency http://eea.eionet.europa.eu/Public/irc/eionetcircle/leac/library?l=/international_classifica&vm=detailed&sb=Title

Forest Trends http://www.forest-trends.org/programs/services.htm

Gothenburg University Environmental Economics Unit on-line library http://www.handels.gu.se/econ/EEU/

ICLEI www.iclei.org; http://www.iclei.org/index.php?id=805

Resilient communities and cities http://www.iclei.org/index.php?id=803

Viable local economies http://www.iclei.org/index.php?id=1651

The International Institute for Sustainable Development (IISD) http://www.iisd.ca/publications_resources/

The International Society for Ecological Economics http://www.ecoeco.org

The Katoomba Group http://www.katoombagroup.org/

An outcrop of Forest Trends, dedicating to advancing markets for ecosystem services. http://147.202.71.177/~katoomba/learning_tools.php

University of Malawi & LUANAR
AGROECOLOGY MODULE

Course description:

This course aims at integration of different disciplines and sharing of knowledge and experiences in managing agro-ecosystems. This is a hands-on course which involves both theory and practicals in learning principles and concepts of agro-ecology. It is intended for a wide range of participants including all crops officers, extension and land resources and conservation officers in all the Agricultural Development Divisions (Ministry of Agriculture, Irrigation and Food Security), graduate students, scientists, and staff from the university, technical colleges, NGOs and the private sector. The diversity of participants is crucial for identifying opportunities for development of multidisciplinary research projects for sustainable management of ecosystems.

Course objectives:
The course is designed to enable participants to gain knowledge and skills in agro ecological principles for sustainable agriculture. At the end of the course, the participants will have in-depth understanding of agro-ecological principles and how they relate to sustainable agriculture; and the concepts and skills in participatory research for development. Participants will be expected to develop research project proposals that demonstrate the integration of different disciplines and sharing of knowledge and experiences in agro-ecology.
Duration:
The duration of the course will be for 2.5 - 3 weeks
Topics:

1. Basic Principles of Agro ecology (AE)
    a. Application of AE principles
    b. Field examples
2. Sustainable resource management
    a. Soil
    b. Water
    c. Biodiversity
    d. Integrated pest management
    e. Field application of agro ecology
3. Social dimension of sustainable agro-ecosystems
    a. Gender roles
    b. Poverty and sustainability
    c. Ethno-botany and agro-ecosystems
4. Managing diversity in agro ecosystems
    a. Cropping systems and design principles for sustainable agriculture
    b. Livestock –crop interactions
    c. Field examples
5. Agroecology and climate change
    a. Cropping Systems and climate change
    b. Adaptation & mitigation
    c. Field examples
6. Participatory research process and client oriented research and extension
    a. ABS
7. Research for development in a changing world
    a. Introduction
    b. Local & international perspectives
8. Research project (starting from day 1)
    a. Module report (student project report)

BUNDA COLLEGE OF AGRICULTURE

1. PROGRAMME: BSc in Agricultural Extension and Rural Development
2. COURSE: Quantitative and qualitative data collection methods
3. COURSE NUMBER: ERS 223
4. YEAR: 2
5. PRESENTATION TO: Faculty of Development Studies
6. PRESENTED BY: Department of Extension and Rural Sociology
7. NUMBER OF LECTURERS/WK 2 (Semester 2)
8. NUMBER OF PRACTICALS/WK 2 (Semester 2)
9. METHOD OF ASSESSMENT Course work 40%; End of course examinations 60%
10. AIM OF THE STUDY:

    The aim of this course is to impart knowledge to students on proposal writing, data collection methods and techniques for undertaking social science research.

11. COURSE OBJECTIVES

    By the end of the course, students should be able to:

    - Describe the steps in research proposal writing
    - Develop a research proposal
    - Describe types of data
    - Describe types of measurements
    - Describe sampling techniques
    - Explain the various data collection methods and techniques

12. TOPICS OF STUDY

    LECTURES

    Steps in research proposal writing

    - Choosing research title
    - Cover page
    - Background information
    - Defining the research problem
    - Justifying the research problem
    - Developing research objectives
    - Developing research questions and/or hypotheses
    - Conducting literature review
    - Describing the data collection and analysis methods
    - Developing the research design table
    - Developing the work plan
    - Developing the research budget

    Describe types of measurements

    - Nominal
    - Ordinal
    - Interval

- Ratio

Describe types of data

- Qualitative data
- Quantitative data
- Primary and secondary data

Describe sampling techniques

- Sampling frame
- Sampling population
- Sampling universe
- Sampling unit
- Sampling criteria
- Sampling procedures
    - Probability sampling techniques
        - Simple random sampling
        - Systematic random sampling
        - Cluster random sampling
        - Stratified sampling
        - Sampling with probability proportionate to population size
    - Non Probability sampling techniques
        - Accidental sampling
        - Purposive sampling
        - Quota sampling
- Sample sizes
- Sampling error
- Non sampling error

Data collection methods

- Quantitative data collection methods
    - Panel Surveys
    - Cohort surveys
    - Exit survey
    - Cross sectional survey
    - Sample survey
- Qualitative data collection methods
    - Focus group discussions
    - Key informant interviews
    - Social mapping
    - Obtrusive and unobtrusive observation
    - Participant observation
    - Ethnography
    - In-depth interviews
- Case studies

Data collection tools techniques and instruments

- Structured questionnaire
- Semi-structured questionnaire
- Checklists
- Tests

- Matrix ranking techniques

PRACTICAL

- Write a research proposal.
- Draw a sample
- Develop data collection instruments

13. PRESCRIBED TEXTS (To be revised: Find one good qualitative methods book and another one for quantitative research.)

    Bernard, H. R. (2005). *Research methods in anthropology: Qualitative and quantitative approaches.* Fourth Edition. Lanham, MD: AltaMira Press.
    Maxwell, J. A. (2005). *Qualitative research design: An interactive approach*. Second Edition. Volume 41 in series: Applied social research methods series, L. Bickman and D. J. Rog, eds. Thousand Oaks, CA: Sage Publications.

14. RECOMMENDED READINGS:

    Blaikie, N. (2009). *Designing social research*. (2nd ed.). Cambridge: Polity Press.
    Maxwell, J. A. (1997). Designing a qualitative study. In L. Bickman and D. J. Rog (Eds.). Handbook of applied social research methods (pp. 69–100). Thousand Oaks, CA: Sage Publications.
    Edriss, A. K. (2003). *Passport to Research Methods.* International Publishers and Printers (IPP), Las Vegas.
    Vyas, Seema and Kumaranayake, Lilani. (2006). *Constructing socio-economic status indices: How to use principal component analysis.* The London School of Hygiene and Tropical Medicine and Oxford University Press.
    Chung, K. (2000). Qualitative data collection techniques. In M. Grosh and P. Glewwe (eds.), *Designing and implementing the living standards measurement surveys: Lessons from ten years of experience* (pp. 337–363). Washington, DC: World Bank.
    Rubin, H. J., and Rubin, I. S. (2005). *Qualitative interviewing: The art of hearing data.* Second Edition. Thousand Oaks, CA: Sage Publications.
    Vaske, Jerry. (2008). Survey Research and Analysis: Applications in Parks, Recreation and Human Dimensions. State College, Pennsylvania: Venture Publishing.
    Patton, M. Q. (2002*). Qualitative research & evaluation methods.* Third Edition. Thousand Oaks, CA: Sage Publications.
    Knodel, J. (1993*).* The design and analysis of focus group studies: A practical approach*. In* D. L. Morgan (Ed.), Successful focus groups: Advancing the state of the art (pp. *35*-50*).* Newbury Park, CA*:* Sage*.*
    Knap, N. and Propst, D. (2001). Focus group interviews as an alternative to traditional survey methods for recreation needs assessments. *Journal of Park and Recreation Administration*. Summer 2001. 19(2): 62-82.
    Krueger, R.A. and Casey, M. A. (2000). Focus Groups: A Practical Guide for Applied Research*.* Chapters 1 and 2. Thousand Oaks, CA: Sage Publications.
    Wolcott, H. F. (1999). Ethnography: A Way of Seeing. Walnut Creek, Lanham, New York and Oxford: Alta Mira Press, A Division of Rowman & Littlefield Publishers, Inc.
    Yin, R.K. (1998). "The Abridged Version of Case Study Research: Design and Method." In L. Bickman and D.J. Rog (eds.), Handbook of Applied Social Research Methods. Thousand Oaks, CA: Sage Publications, pp. 229-259.

BUNDA COLLEGE OF AGRICULTURE

1. PROGRAMME: MSc in Rural Development and Extension
2. COURSE: Qualitative Research Methods
3. COURSE NUMBER: ERS 223
4. YEAR: 1
5. PRESENTATION TO: Faculty of Development Studies
6. PRESENTED BY: Department of Extension and Rural Sociology
7. NUMBER OF LECTURERS/WK 2 (Semester 2)
8. NUMBER OF PRACTICALS/WK 2 (Semester 2)
9. METHOD OF ASSESSMENT Course work 40% End of course examinations 60%

10. AIM OF THE STUDY

The course is designed primarily to enable postgraduate students to acquire knowledge and skills in qualitative research methods and techniques for undertaking social science and development research.

11. COURSE OBJECTIVES

By the end of the course, students should be able to:

- Describe the elements of a qualitative research design
- Describe the steps in research proposal writing
- Describe different types of qualitative research
- Explain the various qualitative data collection methods and techniques
- Describe types of qualitative data
- Describe ways of analysing qualitative data
- Examine critical ethical issues in conducting research
- Develop a research proposal

12. TOPICS OF STUDY

Elements of qualitative research design
Steps in research proposal writing

- Choosing research title
- Cover page
- Background information
- Defining the research problem
- Justifying the research problem
- Developing research objectives
- Developing research questions and/or hypotheses
- Conducting literature review
- Describing the data collection and analysis methods
- Developing the research design table
- Developing the work plan
- Developing the research budget

Different types of qualitative research

- Qualitative research
- Descriptive research
- Exploratory research
- Historical research
- Ethnographic research
- Anthropological research
- Policy and/or Issue-focused research
- Development-focused research
- Action research

Qualitative data collection methods

- Focus group discussions
- Key informant interviews
- Social mapping
- Obtrusive and unobtrusive observation
- Participant observation
- Ethnography
- In-depth interviews
- Photo voice
- Case studies

Data collection tools techniques and instruments

- Interviews
- Types of interviews
- Advantages and disadvantages of interviews as data collection techniques
- Interview biases and response effects
- Mail out questionnaires
- Advantages and disadvantages
- Problems of low response rates
- Questionnaires
- Structured questionnaire
- Semi-structured questionnaire
    - Construction of questionnaires
    - Instrument validity and reliability
    - Focus group discussions
- Documentary sources
- Observations
- Checklists
- Tests
- Matrix ranking techniques
- Visual methods: maps, diagrams, and drawings

Types of data

- Primary data
- Secondary data

Methods of qualitative data analysis

- Coding
- Thematic analysis
- Content analysis
- Critical discourse analysis

Ethical issues in research

- Ethical considerations/Code of ethics
- Gaining access
- Risk and harm

Practical: Proposal Writing

- Write a research proposal.
- Draw a sample
- Develop data collection instruments

13. PRESCRIBED TEXTS:

Laws, S., Harper, C. & Marcus, R. (2003) *Research for Development: A Practical Guide.* London: Sage.

Maxwell, J. A. (2013) *Qualitative Research Design: An Interactive Approach* (3rd edn). London: Sage

Curtis, B. & Curtis, C. (2011) *Social Research: A Practical Introduction*. London: Sage.

Bernard, R. H. (2011) *Research Methods in Anthropology: Qualitative and Quantitative Approaches* (5th edn.). New York: Altamira Press.

14. RECOMMENDED READINGS:

Berg, B. L. (2000) Qualitative Research Methods for Social Sciences. Allyn & Bacon

Gilbaldi, J. (1999) MLA Handbook for Writers and Research Papers. (5th edition). The Morden Language Association of America, New York.

Mauch, J. E. and J. W. Birch (1998) Guide to Successful Thesis and Dissertation. Marcel Dekker Inc, New York.

Lilongwe University of Agriculture and Natural Resources
Syllabus
Programme: PhD in Rural Development & Extension
Course Name: Systems Thinking and Practice in Rural Development
Course Code: ERS 621
Presented to:
Presented by: Faculty of Development Studies
Presented by: Department of Extension and Rural Sociology
Number of Lecture Hours per Week:
Number of Practicals per Week:

Introduction
In this course learners will appreciate and better comprehend the complexities of real-life situations and the interaction of systems in their field of work – agriculture, natural resource management, health, community development, etc. Learners will learn how to develop a framework to systematically analyse these complexities, how to come up with practical solutions, and make informed decisions. From the course, learners will develop a holistic thinking in analysing situations.

Aims of the Course
This course aims to enhance learners understanding of concepts, theories and methodologies in systems thinking and practice, and develop their analytical skills in analysing complex and uncertain situations to address challenges faced in rural development.

Learning Objectives
By the end of the course, learners will be able to:

- Explain systems concepts, theories and perspectives.
- Describe the evolution of the systems approaches to agricultural innovation.
- Demonstrate the application of systems methodology in systemic inquiries and action research.
- Describe the different ways how systems thinking can be applied in planning, implementation and management of rural development interventions.

Course Content:

- Introduction to systems thinking (or Systems thinking)
- Perspectives in systems thinking and implications in rural development
- Systems approaches to agricultural innovation
- Systems maps and diagraming
- Social systems and learning systems approaches
- Systems thinking and practice in Action Research

References
1. Ison, Ray (2010) Systems Practice: How to Act in a Climate-Change World. Springer: London.

2. Peter, Checkland (1990) Systems Thinking, Systems Practice: Includes a 30 Year Retrospective, John Wiley & Sons.

3. Blackmore, Chris (Ed.). (2010) Social Learning Systems and Communities of Practice. Springer: London.

4. Jan Fagerberg, David C. Mowery, Richard R. Nelson (Editors) (2006) The Oxford Handbook of Innovation. Oxford University Press.

Appendix E: Joint Research Proposals Awarded

1. **NATIONAL INSTITUTES OF HEALTH: "The Intersectoral Fellowships to Build Capacity on Irrigation, Agricultural Production, and Health in Malawi"**
   $1,749,715

Project Overview:

The *Intersectoral Fellowships to Build Capacity on Irrigation, Agricultural Production, and Health in Malawi* program aims to provide multi-disciplinary research training for twelve post-doctoral fellows (four from the United States and eight from Malawi), emphasizing the strong interaction of agriculture, water resource development and utilization for agriculture (irrigation), and malaria The program will focus on the process of land and water transformation via the Green Belt Initiative (GBI), a massive undertaking involving irrigation and agriculture development in Malawi. The goal is to increase agricultural productivity by reducing dependency on rainfall and bring more hectarage into production, improving the rural economy. *Our goal* is to mitigate the adverse health impacts of the GBI. We view the GBI as representative of other large-scale programs occurring across Africa. This project utilizes the Malawi setting as a research and training laboratory. Rarely is it the case that large scale, water-based agricultural development includes simultaneous and parallel development of the expertise and infrastructure required to obviate and minimize the concomitant infectious disease risks. Research and training activities will center on empirical and modeling analyses of the ecological and social dimensions of the transformation which will result from the GBI: the disease risks created by expansion of surface water, its effects on mosquito vector populations and subsequent malaria transmission and prevalence, and how these risks can be diminished through interventions that stanch malaria transmission yet maintain the agricultural production goals and desired economic benefits. The long-standing collaborations between Michigan State University (MSU), University of Michigan (U-M), and University of Malawi and between MSU and Lilongwe University of Agriculture and Natural Resources (LUANAR) will provide the training context. The International Center for Excellence in Malaria Research (ICEMR), a MSU – U-M - University of Malawi consortium funded by NIAID, will serve as a locus for the research, as will ongoing studies of malaria transmission and food security. The collaboration will engage a multi-disciplinary group of faculty with particular expertise in (1) ecology and epidemiology of malaria within the land transformation and land use change process; (2) irrigation systems, land transformation, and agricultural production; (3) governance, policy, and implementation; and (4) ecosystem services and integrity. This collaboration will engage experienced scientists and carefully chosen postdoctoral fellows in coordinated research, implementation, scholarship, and consultation. The end results will be a cadre of trained professionals prepared to support agricultural development while, at the same time, preventing malaria-associated morbidity and mortality.

2. **PARTNERSHIPS FOR ENHANCED ENGAGEMENT IN RESEARCH (PEER) SCIENCE: "Soil carbon distribution and dynamics in Malawi: a unique opportunity to optimize sustainable land use and enhance food security" - $145,048 over three years**

Project Overview:

To ensure food security for the world's burgeoning population and to cope with limited fossil fuel supplies, it is essential to understand how resource-limited farmers can manage soil quality. Because of its key role in soil fertility and agricultural productivity, it is essential to understand land management and agricultural practices that enhance soil carbon. Collaboration with the U.S. partner's NSF-funded long-term ecological research site for row crop agriculture affords the opportunity to address a knowledge gap, through a unique opportunity to revisit more than 1,000 soil sites in Malawi where soil carbon was quantified at multiple depths two decades ago. This project will be carried out by a team

from the University of Malawi, supported by Michigan State University soil ecologists and agronomists. Examining patterns and controls of soil organic carbon storage is critical to understanding ecosystem processes and its feedbacks to the atmospheric composition, rate of climate change, soil fertility, and agricultural production. Carbon credits have been proposed as one way to support African farmers while achieving soil conservation goals and reducing greenhouse gas emissions, but there is a void of knowledge concerning soil carbon status on smallholder fields. Furthermore, spatio-temporal patterns of soil carbon aggradation or degradation across African agricultural landscapes remain one of the largest unknowns in food security policy planning. The goal of the project is to understand soil carbon spatio-temporal patterns and processes in Malawi and explore the impact of agricultural land management as it relates to food productivity in the country. This data to be gathered and analyzed and the capacity building for Malawian participants will directly address the key development priorities, including promoting food security and improving land productivity.

Summary of Recent Activities:
During the months of October through December 2013, the research team continued soil chemical analysis using the laboratories at the Biological Sciences and Chemistry departments. Through collaboration with the Michigan University, the team successfully sourced a soil digester. Electronic soil maps for Malawi are being generated using the 1990 baseline data and will be later compared with the newly generated Malawi soil maps. In the next quarter, the team will continue collecting soil samples and will continue conducting soil analysis for draft report submission and final thesis. Sequencing of pictures and video clips continues. The research team will continue entering and cleaning up the survey data and will be preparing the manuscript of the handbook on soil carbon and soil fertility dynamics for improved land productivity and food security. Conferences and stakeholder meetings are being planned as well.

3. USAID-funded GLOBAL CENTER FOR FOOD SYSTEMS INNOVATION: "Creating a 'profile' of legume use, demand, and exchange in informal urban markets" (One part of a two-part MT2 submission)

Project Background:
The GCFSI core team is charged with conducting a number of mutually reinforcing, collaborative 'implementation activities' that will contribute to answering the following question: "Where and how can multipurpose legumes be scaled for sustainable intensification of maize systems and what would the potential impacts be, in the medium term, across the food system in Malawi?" Recognizing that this is a complex question with many dimensions, teams will apply diverse, yet complementary, research approaches and perspectives towards an articulation of concrete recommendations. An underlying and equally important goal of implementation activities is to contribute to the development of a solid foundation for the GCFSI upon which future implementation activities and research and will develop. In effect, the collective purpose of initial implementation activities is to create a template, or substrate, upon which future activities will be built. This goal necessarily implies that processes for creating networks and learning will be an important consideration to build into research and development activities.

Project Description:
One dimension of increasing the sustainability of farm systems is to incentivize demand for the products that comprise such systems. In the current implementation project, it is hypothesized that increasing integration of legumes into smallholder maize-based systems will improve regional food system sustainability. Farmer adoption of such sustainable methods can be improved by demonstrating and developing the marketing opportunities for the outputs of such systems. In this respect, urban demand

will play a key role in incentivizing adoption of sustainable production methods.

4. **USAID-funded GLOBAL CENTER FOR FOOD SYSTEMS INNOVATION: "Food security and sustainable livelihood through solar powered water pumping for irrigation and drinking water purification"**

Project background:
Malawi is one of the poorest countries in the world and faces serious food security issues. Making matters worse is Malawi's lack of safe water supplies, which leads to poor hygiene and disease. Another common obstacle the people of Malawi face is poor infrastructure, including damaged and unpaved roads and unreliable or no electricity. Further, the agricultural sector in Malawi faces several obstacles including low production and heavy reliance on food imports just to meet domestic requirements. An over-reliance on rain-fed irrigation keeps Malawi from increasing agricultural production in the near future. Despite the notable adversity faced by the agricultural sector in Malawi, it still remains the main source of Malawian economic activity. Therefore, it is important to improve agricultural production, which in turn will improve the overall health and incomes of a significant number of Malawians.

Goals and Objectives: The ultimate goal of the project is installation of solar water pumps (SWPs) for irrigation in areas that have limited access to water. This will enable cultivation of up to two crops a year, produce electricity, and to provide clean drinking water. In order to achieve above goals, we are proposing to execute the project in three phases:

- Phase 1: Identify up to three sites in Malawi that are suitable for successful installation and operation of the SWPs
- Phase 2: Install three SWPs, monitor change in crop yield, and train 10 local farmers to operate and maintain the system
- Phase 3: Install 100 SWPs and educate up to 30 people to operate and maintain the system

This proposal only discusses the first phase of the work, which will conclude by September 30, 2014.

Background: The State of Rajasthan in India has become the world leader in the area of solar water pump technology. While Rajasthan makes up 10% of India's land area it only contains 1% of water resources (a disadvantage by a factor of ten for supply of irrigation water versus agricultural area). Acute water shortage, erratic rainfall and recurring droughts have exacerbated the situation. To address these problems, the solar water pump program was scaled to unprecedented heights. From a mere target of 50 in 2010-11 it was scaled to 10,000 for 2013-14. The program was so successful that the long term plan is to install 100,000 SWPs in the next five years. The lessons learned from Rajasthan is a great asset to replicate such a successful system in Malawi, which faces problems similar to Rajasthan.

5. **USDA/USAID TRILATERAL CAPACITY BUILDING PARTNERSHIP: "University-capacity building partnership among MSU, Tamil Nadu Veterinary and Animal Sciences University, and LUANAR"**

This partnership will jointly develop and implement capacity-building programs that effectively mitigate weaknesses and exploit opportunities for African agricultural education institutions to support national development objectives. The dairy activities that MSU proposes for the program demonstrates a clear understanding of USAID's Feed the Future Plan for Malawi and will provide needed support for their dairy sector. MSU will guide partnership composed of Bunda College of Agriculture in Lilongwe, Malawi and Tamil Nadu Veterinary and Animal Sciences University (TANUVAS) in Chennai, India to promote food security in Africa.

Appendix E: Seed Grant Reports

EXTENT OF SYNTHETIC FERTILIZER AND PESTICIDE RESIDUES IN AGRICULTURAL ECO-SYSTEMS: A CASE OF CHIKWAWA AND NTCHEU VEGETABLE PRODUCTION AREAS

Final Narrative Report

Miriam D. Joshua, Felistus P. Chipungu, Willard Kamowa-Mbewe, Charles Malidadi

FEBRUARY 2014

Executive Summary

The Survey results revealed that Njolomole and Mikolongo sections of Njolomole and Mitole E.P.A.s respectively produce a variety of vegetables. Very few farmers grow indigenous vegetables due to limited demand of such vegetables on the market. Thus response to market demands and distance to the markets were some of the reasons provided by farmers for choosing the type of vegetables grown. Types of vegetables mostly grown therefore are those that allow days for transportation and marketing. Such vegetables are like tomato, cabbage, potato and onion which are vegetables that ranked high in Njolomole EPA. While production is both rain-fed and irrigated, intensification is however irrigated production. Very few vegetables such as rape perform well under rain fed without intensive application of chemicals. Both areas utilize chemical fertilizer and pesticides in vegetable production. It was registered that 6% of farmers did not use pesticides. The pesticides are sourced from surrounding markets including Mozambican side for Njolomole EPA. Similarly, the frequency of application varied from village to village and by seasons. The study also established that, in Njolomole, farmers use locally found indigenous pesticides especially when they have no money for chemical pesticides. Although both EPAs are able to produce some high quality vegetables, farmers face limitations to access profitable markets. For instance, farmers indicated high produce congestion as Mozambicans also rely on the same markets. The study also deduced that the most prevalent agricultural pollutants are pesticide residues and nutrient fertilizers. It is envisaged that the soil and water ecosystems are polluted via drainage and irrigation of the field's water overflow of water as well as careless handling of chemicals by farmers in some cases. The vital presence of active chemical components of the major pesticides and chemicals in the soil and crop residues clearly shows the danger posed by the pollutants (chemical residues) both to the ecosystems and human health respectively.

TABLE OF CONTENTS

Introduction

The available land suitable for agricultural production is declining due to environmental degradation that includes soil erosion and soil exhaustion leading to poor plant nutrition (FAO, 2000). Environmental degradation has affected sustainable agricultural production systems in Malawi (GoM, 2010). To increase productivity and quality of produce, synthetic fertilizers and pesticides have been heavily used in agricultural production. In general, the success of modern agriculture as well as the 'green revolution' is in part due to the adoption of synthetic fertilisers and pesticides. In particular, vegetables are generally heavy feeders of nutrients in addition to being prone to disease and pest damages. However, as synthetic fertilizer and pesticide usage increase in vegetable production, there is limited knowledge on their possible effects to the ecosystem as well as to the cultivated crops in Malawi. Currently, there has been no baseline documentation of the presence of residues of the commonly used chemical synthetics in the agricultural ecosystem and their potential effect to human health in the country. Studies have shown that organic fertilisers interact with other heavy metals thereby polluting the environment including quality of water sources (UNEP 2005, Rutherford et al 1995, Schroeder et al 2004). Further, although the use of pesticides such as fungicides, insecticides, rodenticides and herbicides have shown to protect crop plants and therefore reducing losses, the residues of mainly organochlorine and organophosphorous compounds are found in soils, atmosphere and aquatic environments in relatively high concentrations (Carvalho *et al* 1997). Recent studies in coastal areas of Mexico, Nicaragua and Vietnam show that aquatic species such as oyster and clams may contain relatively high concentrations of DDTs, lindane, HCHs, endolsulfan, toxaphene, chlorpyrifos among others (Carvalho *et al* 1997; 2005). The presence of pesticide residues in the environment in places where vegetable production has been intensive over the years cannot be emphasized. Njolomole and Lizulu areas in Ntcheu District are some of such sites where potato and vegetable production has been intensive for supply to most urban areas of Malawi. The production is both, in upland under rainfed in summer and irrigated in lowlands during the dry season. In Chikwawa District urban, vegetables are supplied from Ntwana Village and are produced along the Shire River banks. Chemicals in use include synthetic fertilisers (Calcium Amonium Nitrate (CAN), UREA and 23:21:0+4S) and pesticides that include Dithane to control blight, Dimethoate to control aphids, copper for leaf retention and other insecticides such as cypermethrine, seven, karate, etc. Chikwawa District being prone to effects of climate change, IDRC implemented a project on vegetable intensification as an adaptation strategy for farmers in years 2009 to 2012. The current research intended to determine the extent of residues of commonly used pesticides in Malawi in soils and crop produce from selected sites of Ntcheu and Chikwawa Districts. The knowledge generated will provide the scientific baseline for exploiting and utilising bio-fertilisers and bio-pesticides in vegetable intensification to be piloted in Chikwawa and Ntcheu Districts. Findings will call for the need for more research aimed at sustaining the agricultural ecosystem of Malawi.

This report narrates the achievements of the implementation of the pesticides use project that was conducted in the study sites. The project aimed at assessing the extent of synthetic fertilizer and pesticide in agro-ecosystems using Ntwana village in Chikhwawa and Njolomole EPA as case studies.

1.1 The project goal

The goal of this project was to generate knowledge on the use of synthetic fertilizers and pesticides in the agro ecosystem services for the development of a framework for research and judicious chemical use for a sustainable agro-ecosystem in Malawi.

1.2 Project objectives

The project aimed to assess the extent of the commonly used chemical fertilizers and pesticides in vegetable production and their residues. The research specifically:

i) Determined the current status of soil chemistry in farmers' fields with reference to use or no use of chemicals,
ii) Documented indigenous/local and types of chemical synthetics used, application modes and; dosages.
iii) Analysed synthetic fertilizer and pesticide residues in food produce harvested from currently treated crops and previously treated agricultural land, plant residues and surrounding water systems

2.0 Summary of program activities

This research was implemented in Njolomole and Mikolongo E.P.As of Ntcheu and Chikwawa Districts respectively where vegetable production is high and is characterised with heavy usage of synthetic fertilizers and pesticides. However, the research focussed in selected sections and villages where vegetable production is intensified. In Njolomole, these sections are Njolomole, Mlangeni, Masasa and Chilobwe from which 2 villages were sampled, making a total of 8 villages. In Mikolongo EPA, the study was conducted in 5 villages located in Mitole section. Chikwawa District receives annual rainfall ranging from 170 to 967mm with a mean annual temperature of 37.6ºC. Ntcheu receives high rainfall amounts from 1200mm and above and temperature ranges from 18 ºC to 25 ºC. These two areas are contrasting agro- ecologies.

2.1 Determine the extent of pesticide residues in farmers' fields and crop produce with reference to use or no use of pesticides

To achieve objectives one and three, soil samples were collected from;

- Virgin land (no pesticide use as per memory of holder)
- Continuous vegetable cropping land with use of pesticides
- Field crop/plant residues (rainfed, virgin land and irrigated)

Differences in topography were also considered especially in Ntcheu (Njolomole) where some gardening is done in hilly areas and other in lowlands.

The pesticide analysis was done at Bunda College of Agriculture (The University of Lilongwe) while the soil physical and chemistry was done at Bvumbwe Research Station. However, on farm- and on-station controlled trials were not implemented due to delayed remittance of funds. Samples of vegetable produce were to be harvested from currently treated crops and previously treated agricultural land and for rain fed and irrigated crops. This was not achieved also due to delays in finance disbursement.

2.2 Documentation of indigenous and synthetic pesticides

To achieve objective two 'documenting indigenous/local and types of chemical synthetics used, application modes and dosages a survey was conducted in study area through;

- Focus group discussion (women and men combined with a wide age range)

- Key informants interviews
- Household interviews
- Direct observations

A checklist for focus group discussions covering each objective was developed and was covered in *Chichewa,* a language widely spoken both in Ntcheu and Chikhwawa.

Observations were done to validate some data obtained from the interviews. For example these included small transect walks through the village and taking pictures of the reported vegetables produced and production methods including indigenous pesticides used in the village and applicators (equipment).

3.0 Results and discussion

3.1 Survey results

3.1.1 Types of vegetables grown

Survey results revealed that Njolomole and Mikolongo sections of Njolomole and Mitole EPAS respectively produce a variety of vegetables. Priority varied from one village to the other even within a section. In Njolomole, the four top most vegetables in general and in their order were: tomato, potato, onion and cabbage while in Mitole; they were mustard, Rape, Chinese cabbage and cabbage. Other vegetables grown were carrot, green pepper, snap beans, garlic, pumpkin and bean leaves, lettuce, spinach, egg plants okra, amaranthus and cauliflower. These results imply that farmers prefer to grow exotic to indigenous vegetables. Very few farmers grow indigenous vegetables due to limited demand of such vegetables on the market. Thus response to market demands and distance to the markets were some of the reasons provided by farmers for choosing the type of vegetables grown. At Ntwana Village, Mitole EPA, market is very close to the production area and therefore ideal for the leafy vegetables such as rape, mustard and Chinese cabbage which are highly perishable. Harvest of such vegetables is usually conducted very early in the morning for same day marketing or in the evening for next day marketing. However, the markets of Njolomole area are conduit centres to urban markets, mainly Lilongwe, Blantyre and Zomba. Types of vegetables mostly grown therefore are those that allow days for transportation and marketing. Such vegetables are like tomato, cabbage, potato and onion which are vegetables that ranked high in Njolomole EPA.

3.1.2 Vegetable production seasons

While production is both rain-fed and irrigated, intensification is however irrigated production. Among other reasons, rain fed production is constrained by heavy presence of pests and diseases hence requiring a lot of pesticides which are too costly for most of the poor farmers. Very few vegetables such as rape perform well under rain fed without intensive application of chemicals. Dry season production is mainly restricted to *dambo* areas. Though access to *dambo* land is limited, farmers share the plots with fellow villagers.

3.1.3 Types of fertilisers and pesticides used in vegetable production

Both areas utilize chemical fertilizer and pesticides in vegetable production. Commonly used fertilizers include Calcium Amonium Nitrate (CAN), UREA and 23:21:0+4S (*chitowe*). Most pesticides used were common for all the study villages, though a few were particular in other sites. In irrigated crops, the widely used chemical was Karate (43% of respondents) followed by Logo (13%), cypermethrine (11%)

and Dithane (10%). Tomato (29%) was the most sprayed crop followed by mustard (11%), then onion, cabbage and rape (10%) and potato (8%). It was learnt from key informants and focus group discussion that banned chemicals such as DDT were also used by farmers. however, their application was not captured in the household interviews probably due to sensitivity of the issue. It was registered that very few (6%) farmers did not use pesticides. The pesticides are sourced from surrounding markets including Mozambican side for Njolomole EPA. Different tools are used for pesticide application and observation of safety days varied by individuals and seasons, and not necessarily by instructions. Similarly, the frequency of application varied from village to village and by seasons.

The study also established that, in Njolomole, farmers use locally found indigenous pesticides especially when they have no money for chemical pesticides. However, the waiting period and dosages varied from one village to another suggesting a need for a study to determine the safety period as well as recommended application modes and dosages for these products. From farmers perspective, these indigenous pesticides are effective and affordable for the farmers compared to chemical pesticides.

3.1.4 Constraints to vegetable production

Although both EPAs are able to produce some high quality vegetables, farmers face limitations to access profitable markets. For instance, farmers indicated high produce congestion as Mozambicans also rely on the same markets. It was revealed that the Mozambicans usually have a price advantage of their produce since they have a cheaper source of pesticides from their inland shops in addition to having unlimited access to land that allow extensive vegetable production using family labour.

It was also revealed that for villages away from these main markets namely Lizulu, Mlangeni and Bembeke, farmers prefer vendors to buy their produce from their fields. Many reported that at a great distance, a combination of production costs, high transport costs to markets, post-harvest losses incurred on the way to the market and low market prices is higher than the proceeds realized when the farmers take their produce to the market. Unfortunately, prices are determined/offered by the vendors when the vegetables are sold from the fields.

The main challenge of dry season vegetable production in Njolomole EPA was water for irrigation due to increased water demand arising from increased numbers of farmers; drying up of rivers and reduced residual moisture resulting from forest degradation and declining rainfall pattern especially during the dry season (See figure 1 below) (when vegetable production is intensified). In some villages, farmers scramble for water where those in the upstream make dams and therefore limiting down stream flow. Other farmers water their crops during mid nights, but it was noted that this is a challenge to female headed households due to security reasons.

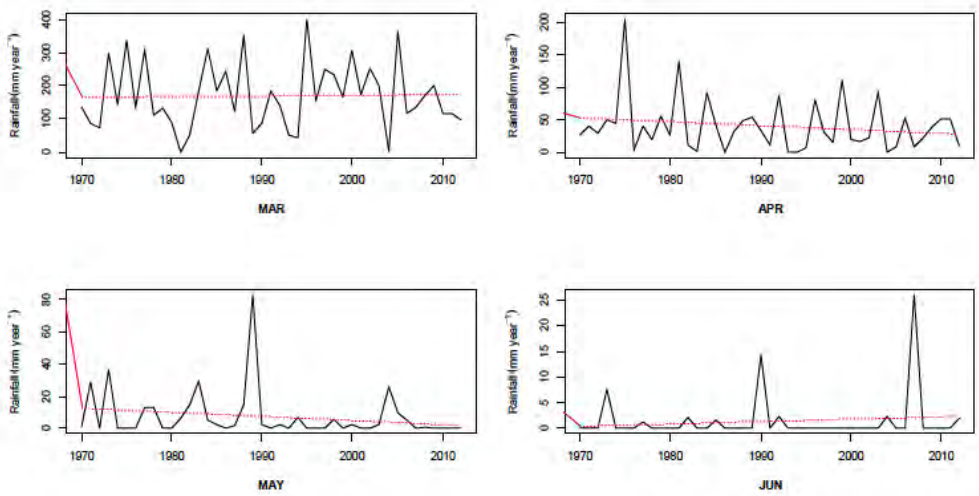

Figure 1 Dry season rainfall pattern in Njolomole, 1970-2013

In general, vegetable production was indicated not to be cost effective especially in Njolomole EPA as farmers buy cheap pesticides from vendors (who sometimes mix the chemicals with flour) which ultimately do not work, and therefore demanding further applications assuming resources are available or in worse situations, abandon the crop. Further, due to lack of recommended tools, farmers end up applying too much pesticide through use of local tools such as brooms, implying high costs incurred.

3.2 Soil analysis results

3.2.1 Physical and chemical properties

The study has revealed that most of the soils in Chikwawa and Ntcheu districts are sandy clay as evidenced by the percentage proportions of silt and clay. The soils from Chikwawa were slightly acidic to alkaline with their pH ranging from 6.85 to 8.61 while those from Ntcheu were mostly acidic with pH levels ranging from 4.91 to 6.48. The study has also revealed that there is no significant variation (Fpr = 0.78) in the soil physical properties within each sampled district. For example, the distribution of clay in Ntcheu did not vary significantly (Fpr. = 0.91) from sites to sites. This shows that generally the soils are homogenous and that the significant variation (Fpr <0.42) in soil chemistry is attributed to the application of agricultural fertilizers and pesticide chemicals rather than the parent rock's properties from which the soils were formed. Therefore, it is clear that different fields are being treated differently by different farmers. This agrees with the household surveys in the area which revealed that some farmers were not using chemicals pesticides and agricultural fertilizers, while others were heavily applying the two. It is therefore expected that from such fields, the soil chemistry will be different.

The study also deduced that the most prevalent agricultural pollutants are pesticide residues and nutrient fertilizers. Results of actual levels of pestcides found in produce are underway. It is envisaged that the soil and water ecosystems are polluted via drainage and irrigation of the field's water overflow of water as well as careless handling of chemicals by farmers in some cases.

3.2.2 Extent of chemical residues

The vital presence of active chemical components of the major pesticides and chemicals in the soil and crop residues clearly shows the danger posed by the pollutants (chemical residues) both to the ecosystems and human health respectively. The presence of the chemicals in the soils may have an effect on the soils ecosystems as well as aquatic ecosystems in the downstream. On the other hand, the danger posed by the chemical residues is linked to human health as the crops are consumed by humans either cooked or uncooked (vegetable salad). However, there is need to conduct a detailed study to link the chemical residues and human health since this is a critical area to understand.

4.0 Detail of progress made towards the achievement of project objectives

Outcome statements	**Indicators used to monitor progress**	**Progress made**
Outcome 1: Identification of study sites with high vegetable intensification	Two planning meetings for the research team 1 meeting in each district with District Agricultural Officers and extension workers to identify study sites	Project Implementation work plan developed Research tools developed 8 villages selected from 4 sections of Njolomole EPA (Ntcheu District); 5 villages from Mitole section, Mikolongo EPA (Chikwawa District)
Outcome 2: Conducted key informant, focus group discussions and individual interviews	7 key informants interviewed 13 focus groups conducted 62 individuals interviewed Secondary data collected in addition to participant observation	qualitative and quantitative survey data collected through FGDs, key informant interviews, household interviews and secondary data
Outcome 3: Survey data processed and analysed	Qualitative data thematically analysed-categorized into major emerging themes Quantitative data captured and analysed using software package for social scientists (spss) and STRATA; and relevant statistics of	1 report on survey data compiled

	variables under study generated	
Outcome 4: Soil samples from pesticide treated and untreated plots collected	24 samples from Ntcheu and 12 from Chikwawa were collected	Soil samples sent to Bvumbwe and Bunda for chemical and physical analysis
Outcome 5: Soil samples analysed	Soil samples analysed for physical and chemical properties at Bvumbwe Soil samples analysed for pesticide residues at Bunda	1 report in progress on soil physical and chemical properties Analysis on pesticide residues in progress
Outcome 6: Publications and dissemination of findings	4 possible peer reviewed papers proposed and under drafting	Paper writing in progress for 2014 publications Dissemination meetings in March 2013

5.0 Challenges of project implementation

The biggest challenge was the delayed disbursement of second lot of finances. Controlled trials were planted at Bvumbwe, but only agronomic data was obtained. Crop produce and crop residues could not be analysed for pesticide residues due to lack of chemicals. Similarly, crop produce and residues could not be analysed from farmers' fields; where soil samples were collected for the same reasons.

6.0 Conclusion

A project in Ntcheu and Chikwawa Districts was implemented to generate knowledge on the use of synthetic fertilizers and pesticides in the agro-ecosystem services and the extent of residues in the system. The knowledge so generated is essential in the development of a framework for research and generation of science based policies with reference to judicious use of pesticides for a sustainable agro-ecosystem in Malawi. Surveys were successfully conducted in the study areas and first report was submitted. The results revealed that farmers grow different types of vegetables and use different chemicals of both synthetic and indigenous origins. Only 6% of farmers do not use pesticides, solely for purposes of no resources to access synthetic pesticides. Findings reveal different safety periods from farmer to farmer and by season. Farmers also use locally available tools for applying pesticides. In general, there is need for capacity building on use of pesticides for a sustainable agro-ecosystem.

Future research

We are proposing a multi stakeholder Participatory Action Research in the study areas that will analyse the various dosages and safety periods for both indigenous and chemical pesticides. The research will involve the farmers, entomologists, agricultural officers at local level and from Bvumbwe Research Station, researchers from UNIMA and pesticides stockists. It is expected that the research will help stakeholders to identify and upscale appropriate strategies for healthy and profitable vegetable production. The research will also incorporate rainwater harvesting to address water shortages experienced during dry season production. This takes advantage of increased rainfall (see figure 2) received during months of January and February but lost as surface runoff. However, we are yet to identify a potential source of funding for this future research.

USAID-FUNDED PROGRAM: AGRO-ECOSYSTEMS SERVICES – LINKING SCIENCE TO ACTION IN MALAWI AND THE REGION

THE ROLE OF CROPPING SYSTEMS IN ADAPTATION TO EFFECTS OF CLIMATE CHANGE AND VARIABILITY

REPORT

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THE ROLE OF CROPPING SYSTEMS IN MITIGATING THE EFFECTS OF CLIMATE CHANGE AND VARIABILITY

a) Executive Summary

Climate change and variability is a challenge to ensuring food security among rural populations in Malawi and sub-Saharan Africa. These populations mainly depend on rain-fed agriculture, but low and variable rainfall pattern, drought, and high temperatures severely affect crop production. Although smallholder farmers have developed different coping and adaptation strategies, there is inadequate information on agricultural interventions that empower smallholder farmers to cope and adapt to the effects of climate variability. This paper reports on cropping systems and coping strategies that different gender groups use to adapt to climate change and variability.

This study was conducted in Balaka and Ntcheu semi-arid districts of Malawi, two Extension Planning Areas (EPAs) per each district were purposively sampled based on their vulnerability to climate change. The aim of the study was to assess the extent to which cropping systems are used for adaptation to climate change and variability, and if gender has an influence on the choices. Data were collected through household interviews, key informants interviews and focus group discussions. A total of 120 farmers were interviewed, 55% male-headed and 45% female-headed households. Two focus group discussions were conducted per each Extension Planning Area, women and men were interviewed separately, and a total of 8 focus group discussions were conducted in the two districts. The key informants who were interviewed included the District Agricultural and Development Officer, Agricultural Extension District Coordinator, community leaders and representatives from nongovernmental organizations working on climate change and agricultural issues.

The results from farmers' perceptions revealed that the indicators of climate change were late onset of rains, early cessation, low amount of rainfall, erratic rains, short rains, dry spells, floods, increasing temperatures and unpredictable rainfall distribution. This has negatively affected agricultural production, a livelihood that the majority of the households depend on. The findings show that 71% of the male-headed households and 69% of the female-headed households depend on agriculture as a major source of livelihoods. As a way of sustaining their livelihood and adapting to climate change, many households have adopted new ways of farming. The study revealed that 72% of the households are growing hybrid maize, this is diverting from local maize that was grown by the majority in the past. This can be attributed to increased access to hybrid seeds die to FISP by the Government of Malawi and supply of hybrid seed on the market. However, it was observed that in Ntcheu district, a higher proportion of MHH (88%) than FHH (68%) use hybrid maize, but no differences observed in Balaka. The overall estimated grain yields were the same for MHH and FHH. In Ntcheu, the trend shows that the estimated grain yield of hybrid maize was slightly higher for FHH than male farmers (1.52 t ha^{-1} vs 1.24 t ha^{-1}); and the opposite trend was observed in Balaka, 1.12 vs 0.86 t ha^{-1}. The change is also evident in other cropping system and soil fertility management. The results showed that 55% of the households are practicing intercropping of legumes with cereals or cotton as a way of crop diversification in space. It was also observed that more women than men were using compost manure and incorporating crop residues to improve soil fertility and conserve soil moisture, whereas more men were reported to be applying inorganic manure. The change in the cropping system has assisted households to mitigate the effects of climate change on crop production. However, respondents reported erratic rainfall, seed shortage, low access to farm inputs and low soil fertility as some of the constraints to increased crop production.

Furthermore, the findings revealed that households in the study area adapt to climate change and variability through other sources of livelihood such as business, ganyu (temporary employment) and

remittances. Ganyu was reported a popular adaptation strategy among both men and women although women indicated that they were not involved in ganyu before the climate change impacts were evident in the study areas. These findings have revealed that communities in Balaka and Ntcheu have adopted new technologies and cropping systems to adapt to climate change and variability. This poses a challenge to scientists and researchers to develop technologies that respond to communities' needs and environment. The findings on cropping systems imply that in the recent years, some of the gender biases that used to be there might have been eroded. Further studies are required to assess the determinants and sustainability of this change, and whether the benefits spill over to the households.

b) ACKNOWLEDGEMENTS

This study was funded by the Agro-Ecosystem Seed Grant through the USAID funded Agro-Ecosystems project: Linking Science to Action in Malawi and the Region", a collaborative project with partners from Michigan State University, Lincoln University, Lilongwe University of Agriculture and Natural Resources and University of Malawi- Chancellor College. The researchers are also very grateful to Dr D. Kambewa for playing an advisory role towards the study.

The study was carried out in Phalula and Rivirivi Extension Planning Areas in Balaka district, and Manjawira and Sharpe Valley Extension planning areas in Ntcheu district. The entire group of respondents (Focus Group Discussions and household interviews) deserve great appreciation for their tolerance and patience during data collection. We are also grateful to the staff of Balaka and Ntcheu District Agriculture Offices and other key informants for providing useful information for the research that has formed part of this report.

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KEY TO ABBREVIATIONS

ADD : Agriculture Development Division
EPA : Extension Planning Area
FGDs : Focus Group Discussions
IPCC : Intergovernmental Panel on Climate Change
MoAFS : Ministry of Agriculture and Food Security

Chapter One: INTRODUCTION

Climate change and variability is one of the major constraints to agricultural production and food security. In Malawi, over 90% of the rural Malawian population depends on rainfed agriculture for food security and livelihood. Rainfall distribution is unimodal starting in November or December to March/April. A majority of farmers are with average land holding size of <1 hectare in the southern region to 1.5hectare in northern Malawi. Maize is the main staple food crop grown by 90% of the smallholder farmers and contributes to 50% of calories intake (Government of Malawi, 2006; Makombe *et al.,* 2010). Over 70% of arable land is planted to maize (Alwang and Siegel, 1999) which is a staple food. The maize is planted as sole crop, intercrop or rotated with leguminous crops. There are three main varieties: hybrids, composite and local maize. Other major crops grown are groundnut, pigeonpea, soybean, common bean, cowpea, sweet potatoes and cassava. The grain yield of maize average <1, 1.5 and 2 t ha^{-1} for local, composite and hybrid maize varieties, respectively against their average potential yield of 3, 5 and 10 t ha^{-1} (MoAFS, 2012). Between 1992 and 2004 average yields were 1.1 t ha^{-1} and then increased from 2005 to 2008 with an average yield of 1.7 t ha^{-1} (MoAFS 2007; 2012). In 2011/12 growing season, maize was grown on 1,497,829 ha of land with an average yield of 2.0 t $ha.^{-1}$ In addition, legumes are increasing becoming important, with a production area 978,582 ha (MoAFS, 2012). The policy of the government is to increase yield per unit area in order to meet increasing demand for the growing population and release land for other food and cash crop (MoAFS, 2005). Declining soil fertility has been regarded as the main cause for low maize productivity in Malawi (Kumwenda *et al.,* 1997; ICRISAT/MAI, 2000; Blackie and Mann, 2005; MoAIFS, 2005). Another growing constraints to low yields is unpredictable onset and distribution of rainfall. Famers are unsure with planting rains, many times early plantings being scorched or growth severely retarded with erratic rains early in the season. The recent increase in maize yields provides an opportunity for farmers to diversify to more drought resilient crops or cropping systems. In this study, we collected data from smallholder farmers on cropping systems and effects of climate variability on productivity of agricultural systems and how this impacts on livelihoods. A cropping system can be defined as cropping patterns (arrangement of crops) in space and

over time and the management practices that are used on a particular field (Palaniappan and Sivaraman, 1996).

In Malawi and other countries in SSA, evidence of climate variability and impacts on agricultural production has been reported. Farmers have experienced a decline in crop productivity due to late on set of rains, dry spells, floods that sometimes wash away arable land in addition to damaging property. According to National Climate Change Program (NCCP), 2013-2016, Balaka district and lakeshore areas of Ntcheu district are among the areas that are vulnerable to climate change. A few studies have been done on climate variability and yield of maize in selected districts of Malawi and adaptation strategies (Clay *et al.*, 2003; Kakota 2011, Matiya *et al.,* 2011). Kakota (2011) found that rainfall variables (amount and number of rain days) have either positive or negative effects on maize yield depending on rainfall distribution. The effects of climate variability on crop productivity is influenced by crop species, growth stage at which a stress is introduced, cropping systems and soil properties. In Malawi, not much research has been done on modeling crop productivity in the future in relation to climate change and variability. However, farmers are experimenting on different cropping technologies to adapt to climate change and variability.

Previous research work in Malawi have documented some adaptation strategies that have been adopted by smallholder farmers and these include: planting drought tolerant or early maturing crops, crop diversification, selling assets, migration, small scale businesses and soil and water conservation technologies (Stringer *et al.*, 2009; Stringer *et al.*, 2010; Kakota 2011; Matiya *et al*., 2011). Although such studies have been conducted in Malawi, most of these strategies are generalized. There is paucity of information on the specific adaptation strategies in relation to cropping systems. This study therefore, was designed to unveil farmers' choice of cropping systems and technologies to adapt to climate variability and change, and also factors that influence their choices. The findings from this socio-economic study will be used to design participatory on-farm trials to determine agronomic practices and cropping technologies that optimize productivity of maize and selected grain legumes.

Objectives of the study

The main objective of this research is to evaluate productivity of cropping systems in different agro-ecological zones of Malawi in relation to climate change and variability. The Agro-ecosystem Seed Grant was used to address the following objectives:

a) Determine the cropping systems and technologies that farmers use to adapt to climate variability and the factors influencing choice;
b) Assess whether gender of the head of household influence the choice of cropping technologies and vulnerability to climate change.

The findings from this study will be used in next phase of agronomic studies aimed addressing the following objectives: Predict the yield of maize and selected legumes under various cropping systems in relation to climate variability; identify agronomic practices and cropping technologies for optimizing productivity of maize and selected grain legumes under variable weather patterns, cropping systems and tillage practices (conservation and conventional systems); to recommend the relationship/link between farmers' choice and effective cropping systems.

Chapter Two: LITERATURE REVIEW

2.1 Climate Change versus Climate Variability

The intergovernmental Panel on Climate Change (IPCC) defines climate variability as the spatial and temporal variations in the mean, standard deviation and occurrences of extreme events of the climate,

for example, temperature and rainfall (IPCC, 2001). Climate change, on the other hand, is defined as any change in climate over time whether due to natural variability or as a result of human activity (IPCC, 2007). This definition complements that by the United Nations Framework Convention on Climate Change (UNFCCC) which defines climate change as a change in climate attributed directly or indirectly to human activity that alters the composition of the global atmosphere, and that is in addition to natural climate variability observed over comparable time periods (IPCC, 2007; UNDP, 2009). Climate variability can be determined between and within seasons while climate change factors require long-term data of about a decade or more.

Evidence of climate variability include the following: seasonal changes in rainfall amount; number of rain days; start of the rains; temperature and frequency of extreme weather events. Climate change can be ascertained through its effects that include frequency and intensity of extreme weather events (e.g. floods and droughts). The definition adopted in this study is not limited to whether the variability or change is attributed to natural or human activity. This study acknowledges the complexity of validating climate change and therefore focuses on the effects as perceived by the communities. However, climate variability was determined using rainfall and temperature data. In Malawi, floods and droughts have increased in intensity and frequency since the year 2000 (GOM, 2006). Late rains (onset of planting rains) are occurring every year in most parts of the country. It has also been observed that in some areas, planting time has shifted from November to December or January and late planting has negative effects on productivity of long duration crops. In the agricultural sector, areas most affected the negative effects of climate change are the semi-arid districts. Therefore this study was conducted in two districts representing the semi-arid areas of Malawi to assess the effects of climate variability crop productivity and livelihoods in general; and farmer's adaptation strategies.

Climate change and variability are the major challenges to increased crop productivity and food security. Although they are natural phenomenon that vary with time and space, the current effects observed globally are beyond and above the natural variability (Ribot *et al*., 1996; IPCC, 2007). Its impacts on humans, ecosystems and livelihoods have largely been documented (UNEP, 1999; Ashton, 2002; Brooks, 2004; IPCC, 2007; Battisti and Naylor, 2009; Mendelsohn, 2009). This has raised interest in international debates, and issues on climate change and variability have thus dominated the global environmental agenda since mid-1980's ((Miller, 1996; Middleton, 1999; UNEP 2000; UNFCCC 2005; IPCC 2001; WWF 2002). Likewise, adaptation and mitigation issues have become global and national priorities. Hence, this study responds to the urgent demand for studies which address adverse effects in the most vulnerable areas to assist vulnerable communities to effectively cope and adapt.

2.2 Cropping Systems

In Malawi, over 90% of the rural Malawian population depends on rainfed agriculture for food security and livelihood. Rainfall distribution is unimodal starting in November or December to March/April. A majority of farmers are smallholders with average land holding size ranging from <1 hectare in the southern region to 1.5 hectares in northern Malawi. Cropping systems are dominated by maize, the staple food, occupying over 70% of arable land (Alwang and Siegel, 1999), legumes occupy 10-15% of arable land. Examples of cropping systems include monocropping (one crop in a field), intercropping (two or more crops on same piece of land), crop rotation, agroforestry (trees with pastures or crops). Types of intercropping include row intercropping, strip intercropping, mixed cropping and relay cropping. Successful intercropping requires selection of component crops with complimentary characteristics below and above ground, and proper management practices (Hauggaard-Nielsen *et al.,* 2007). Productivity of cropping system depends on the genotypes, environmental resources (e.g. soil characteristics, climate factors, moisture gradients, pests) and management practices. Cropping systems

based on ecological principles provide diversified ecosystem services. Some of the ecological principles for sustainable agricultural systems include biodiversity of plant species, integrated pest management, and socio-economic dimensions of production (Altiei, 1999; Snapp, 2008). The main cropping systems for maize are sole, intercrop or rotation with leguminous crops. Other major crops grown are groundnut, pigeonpea, soybean, common bean, cowpea, sweet potatoes and cassava.

Balaka district is predominantly a low altitude area with short and erratic rainfall. Ntcheu district, on the other hand, has a blend of low and mid-altitude landscapes, resulting in some areas experiencing higher rainfall and cooler climate. The national crop estimates, which records the crop areas and yields, does not segregate sole and mixed cropping systems (MoAFS, 2007; MoAIWD, 2012). Crops commonly grown in both districts include maize, sorghum, cassava, pigeonpea, cowpea, sweet potatoes, soybean, groundnuts, dolichos beans and ground beans. (MoAFS, 2007; MoAIWD, 2012). Where the rains are short and erratic, cropping systems include short season varieties and mixtures and patterns that hedge against crop failure. In Malawi, nearly all crops are planted on ridges, with the spacing of most crops being aligned to that of maize, the staple cereal, which is 0.75 m apart (MoAFS, 2012). Other crops however have different recommended ridge spacing. For example, the spacing for tobacco and cassava is 0.90 m (MoAFS, 2012). Most legumes such as pigeon peas, beans, and cowpeas are recommended to intercrop with maize. As may be expected, farmers adopt recommendations to varying degrees. Intercropping is a predominant practice in Malawi, including Balaka and Ntcheu districts **(**Kabambe, et al., 1998; Kamanga, 2001). Farmers practice intercropping for various reasons. Kamanga (2001) reported that Malawi farmers practice intercropping to maximize land use and to add diversity to food production. Mason et al (1986) reported that the main reason for intercropping is flexibility, profit maximization, weed control and balanced nutrition.

2.3 Effects of climate change on crop production

Climate factors (e.g rainfall, temperature, light) affect plant growth and ecological processes such as nutrient and hydrological cycles. In crop production, climatic factors influence ecological processes, plant physiological processes (e.g. germination, photosynthesis, water and nutrient uptake, plant development) and hence potential yields. One way in which climate variability affects productivity is through unpredictable planting dates. Farmers sometimes plant two early, before the full season starts, and suffer from poor crop establishment and poor stand, or plant late, and fail to take advantage of the full season. Poor rains during the grain filling stage can cause up to 45 % yield loss, due to poor pollination and retarded cell division and elongation. Small improvements in water availability at germination stage, through mitigation effects or proper timing could lead to large improvements in establishment. The same would be true at the critical flowering and grain filling stage.

The effects of climate change and variability on agriculture and predictions for the future have been reported. It has been projected that in some countries, yields from rain-fed agriculture could be reduced by up to 50% by 2020 due to climate change (Boko *et al*., 2007). Studies have also found that an increase in temperature would likely increase crop yields in temperate regions whilst negatively affecting production in tropical regions. For example, Tubiello and Rosenzweig (2008) showed that a moderate warming of up to 2^{o}C may benefit crop and pasture yields in the temperate regions, while reducing production in semi-arid and tropical regions. In the case of Malawi, variable and unpredictable weather is one of the major constraints to maize production, the staple food. Previous studies have reported low maize yields and sensitivity to high temperatures associated with climate change (Jones and Thornton, 2003; Long *et al*., 2006; Schlenker and Roberts, 2006; Lobell and Field, 2007; Schlenker and Lobell, 2009). For example, Jones and Thornton (2003) projected a decrease of 10% in maize production equivalent to losses of $2 billion per year in Africa and Latin America by 2055. Another study by

Schlenker and Lobell (2010) conducted in Sub-Saharan Africa found that maize is severely affected by climate change than millet. The overall yield losses for cereals and oilseeds in southern Africa were estimated to exceed 50% by 2050. A study conducted in Malawi found that maize production declined by around 60% due to 1991/92 droughts (Clay *et al*., 2003). These impacts on agriculture have a large bearing on people's livelihoods and food security. But also, the overdependence on rain-fed agriculture, and maize in particular, renders Malawi vulnerable to climate variability and change. Hence, the need for adaptation strategies that will sustain livelihoods and food security among the smallholder farmers in Malawi.

2.4 Adaptation strategies to climate change and variability

Potential strategies to adapt to climate variability include planting drought tolerant or early maturing crops, crop diversification in time and space (intercropping; cropping in main growing season and winter), and conservation agriculture to build soil organic matter and conserve soil moisture, adjusting planting time. However, coping and adaptive abilities vary among households and within individuals in the household. Understanding household strategies to cope with and adapt to the impacts of climate variability and change involves an assessment of both negative and positive strategies adopted by households and factors that influence the choice of coping mechanisms (Adger and Kelly, 1999). But, effective adaptation strategies are those that help to reduce current vulnerability while also decreasing vulnerability to future climate variability (Huq *et al*., 2003).

Chapter Three: RESEARCH METHODS

3.1 Study Area

This study was conducted in Ntcheu and Balaka districts located in central and southern Malawi respectively. Ntcheu is located in Lilongwe Agriculture Development Division (ADD) at 1170m above sea level, and receives 800-1200mm of rainfall annually (Land resources Appraisal, 1993). Balaka district is located in Machinga ADD with annual rainfall of 700-1100mm, and altitude of 625m above sea level. The choice of the two districts was based on their semi-arid climate which provides good case studies on cropping systems that are being used to adapt to climate variability.

3.2 Sample Size and Sampling Design

A multistage sampling was used to select 120 households. Firstly, purposive sampling was used to select the two districts. In each district, 2 Extension Planning Areas (EPAs)[1] were randomly sampled. Households were stratified into male-headed and female- headed and 40 households were interviewed from each EPA making a total of 120 households in two districts of which 45% were female-headed.

3.3 Data Collection and Analysis

Both qualitative and quantitative methodologies were used to achieve the objectives of the study. The quantitative methods were used to ascertain the prevalence of the different cropping systems and technologies that farmers are using to adapt to climate variability. This information was complemented by qualitative data that provided the details of how the different cropping systems are enabling the farmers to adapt to climate variability.

[1] For administrative purposes, the Ministry of Agriculture in Malawi has different zones that are used to work with farmers at the grass root. The country is divided into 8 Agriculture Development Divisions (ADD). Each ADD is divided into Rural Development Programs (RDP), which coincides with the district boundaries. Each RDP is divided into Extension Planning Areas (EPAs), and each EPA is divided into sections. This ensures that farmers are served with agricultural services, including agricultural extension services effectively.

Quantitative data were collected through household surveys that used a semi-structured household questionnaire. The data collected during the survey included household-specific data relating to household characteristics, land holdings, asset ownership, farmers' perception of climate change and its effects, cropping system and management of climate variability. Qualitative data were mainly gathered through focus group discussions (FGDs) with the farmers. Since women dominate the agricultural sector in Malawi, special FGDs with women will be conducted to understand how the different cropping systems that the women farmers use are effective in mitigating the effects of climate variability. Qualitative data were also collected from key informants that included agriculture extension officers, lead farmers, directors and extension officers of local NGOs).

Data from focus group discussion were summarized using content analysis method. Content analysis is the process of summarizing data collected especially through focus group discussions. It is used to determine the presence of certain words, concepts, themes, phrases, characters, or sentences within texts or sets of texts and to quantify their presence in an objective manner. During the analysis, all the responses were organized into various themes for ease of comparing the responses depending on the people's perceptions of the cropping systems that mitigate the effects of climate change.

While focus group discussions and key informant information was directly analyzed after transcription, the data from the questionnaires were entered and analyzed using SPSS while the information from discussions was analyzed using a Grounded Theory. Results are presented in latter sections. Furthermore, secondary data collected from related organizations were also synthesized, which triangulated and complimented the primary data leading to more in-depth analysis and discussion of the results.

Descriptive statistics was carried out to identify cropping systems that are used by male and female farmers and also to compare the capacity of each household to adapt to climate change. Factors that determine the choice of a cropping system and/or technology was analyzed using a multinomial logistic regression. The dependent variable in the model was household's choice of a particular cropping system[2] and the explanatory variables included household level factors (such as age of the household head; gender of the household head, household land size, etc.), institutional factors (such as whether the household head is a member of a farmer group; access to agricultural extension services, etc.), and community-level factors (such as the frequency of droughts in the communities, etc.). To test the validity of the econometric model (i.e. the multinomial logistic regression), the McFadden R-square was used as a measure of the goodness of fit of the model. Further, the Wald χ-square test was used to test the stability of the model.

Chapter Four: RESULTS

4.1 Household characteristics by gender of household head

Table 4.1 shows the various demographic and socio-economic characteristics that describe the sampled farmers in the two districts. The sample was dominated by male-headed households comprising 55 percent of the total sample. The average age of the head of the sampled households was 42, and it ranged from 19 to 71 years. The sampled households had an average household size of 5.2 and there was no significant difference in the average household size of the sampled households in the two

[2] We assume that the range of available types of cropping systems in the research area are more than two, such that determinants of the cropping system used to adapt to climate variability can be modelled using a multinomial logistic regression. If, however, at the time of the study it is discovered that there are only two types of cropping systems being used , a logit model will be used.

districts, with Balaka having an average of 5.0 and Ntcheu with an average of 5.3. The average households are slightly higher than the average household sizes from the 2008 Malawi Population and Housing Census, which recorded an average household size of 4.2 in both districts. The respondents were also asked about household food security (access to food from own crop production) produce. The findings showed that in Balaka district, 32% and 24% of the MHH and FHH respectively were food secure; whereas in Ntcheu district, 28% and 30% of the MHH and FHH reported being food secure.

Table 4.1 also shows the level of education of the sampled households. The results indicate that around 13 percent of all the sampled households had no schooling at all while only around 2 percent had some form of post-secondary education. The education levels did not seem to vary by district. The self-reported annual household income was MWK 68,989 for the sampled households but there was significant difference in the annual income between Ntcheu and Balaka, with Balaka recording a significantly lower income. The difference could be due to under-reporting of income in Balaka[3] or could reflect the differences in income sources[4] between the two districts.

Table 4.1: Household Demographic and Economic Characteristics

Variable	Balaka	Ntcheu	All
Gender Male	44.3%	45.8%	45.0
	55.7%	54.2%	55.0
Age of Household Head	43	41	42
Household size	5.0	5.3	5.2
Education			
No schooling	11.5	13.6	12.5
Adult literacy	1.6	0.0	0.8
Junior Primary	19.7	35.6	27.5
Senior Primary	37.7	40.7	39.2
Secondary school	26.2	10.2	18.3
Post-secondary	3.3	0.0	1.7
Average annual income	MWK 48,163	MWK88,965	MWK 68,989

Figure 4.1 shows the main livelihood sources reported by respondents in Balaka and Ntcheu by gender of the household head. Agriculture is an important livelihood source for both male and female-headed households. The data showed that informal sale of household labour (*ganyu*) was reported more by female-headed than male-headed households. Both male and female-headed households also supplement their incomes from various sources by engaging in non-farm income generating activities. This was reported by around 67 percent of male-headed households and 64 percent of female-headed

[3] Balaka is one of the few districts where there are a lot of relief interventions by the government and NGOs to address the problem of persistent food insecurity. The other districts are Chikhwawa and Nsanje. In many communities of these districts, households have developed too much dependency on free food distribution to the extent that they always underreport their income hoping that they would be registered for a free food or cash distribution.

[4] Our data show that the main income sources reported by households in Balaka include agriculture (70%); remittances (3.3%); sale of household labor (ganyu) (70%) and small-scale businesses (60%). In Ntcheu the sources of income included agriculture (70.7%); ganyu (58.6%); and small-scale businesses (70.7%). The differences in the use of small-scale businesses and ganyu could explain the significant difference in annual incomes between the two districts.

households. These results point to the fact that the majority of the households in the study areas are highly vulnerable to the effects of climate variation because of their dependency on agriculture, since the majority of the *ganyu* also takes place in the farms (see Box 4.1). Strategies to promote the adaptation of the households to the effects of climate variability are necessary to reduce households' vulnerability and promote their capacity to cope with climate variability.

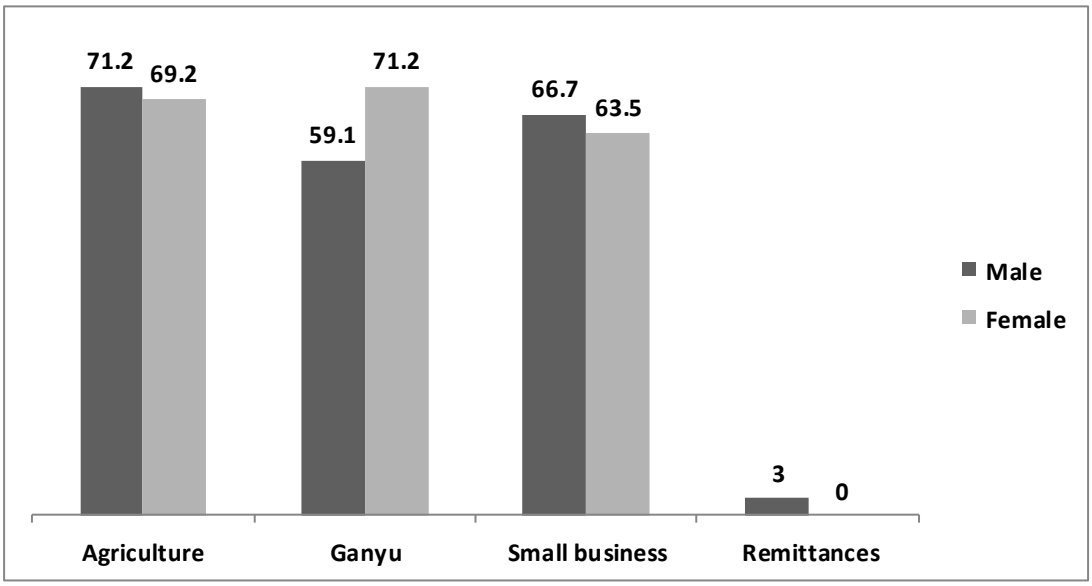

Figure 4.1: Main Livelihood Sources of the Sampled Households by Gender of Household Head (Multiple Response)
Source**:** Own compilation from Survey Data

Box 4.1. Sources of livelihood

Selling household labor locally known as "ganyu" in agricultural related activities is the main and most reliable source of livelihood throughout the year. In a calendar year, we start with land preparation and residue incorporation traditionally known as "kuwojeka"in May-July; uproot stalks in cotton fields in June-July; ridging and finalize land preparation in September-October; planting in November-December; weeding in December-January; and lastly harvesting in February –April depending on crop species and varieties.

Quote from women FGDs, Phalula EPA, April 2013

4.2 Farmers perceptions of climate change and variability in Balaka and Ntcheu districts

Both men and women focus group discussions in Balaka and Ntcheu districts acknowledged that they have experienced some changes in climate over the past years. These changes are related to rainfall patterns, temperature, and wind

4.2.1 Rainfall Patterns

The discussions revealed that communities are experiencing late onset of planting rains. Respondents indicated that previously, in the 1970's and 1980's, planting rains used to come in the last week of October or early November. However, in the recent years, from 2000, late on set of rains has shifted planting dates to second half of December and sometimes early January. When the rains finally come, they stop early. Respondents reported an early cessation of rainfall and in most cases rains stop by March. The findings from the study show that usually the rains stop when the most annual crops are at late vegetative or early reproductive stage.

"The rainfall season is generally shorter than over 20 years ago and this has negative impacts on productivity of most arable crops" FGD, Phalula EPA. April 2013.

The respondents indicated that the problem of poor rainfall distribution is experienced almost every year. Rainfall distribution affects plant growth and biomass productivity. An example was provided for the last season (2012/2013) whereby there was too much rainfall in January and February that reduced crop productivity due to water logging (especially in low lying areas) and fields with pit planting, leaching of nutrients and floods eroded fields. These experiences seem to suggest that water harvesting technologies such as pit planting can be vulnerable to climate change if there is too much rainfall. In additional, the discussions revealed that frequent dry spells are experienced early in the growing season and too much rainfall towards the end of the season. Sometimes the opposite happens whereby a dry spell is experienced when crops are at early reproductive stage. This negatively affects yield for most crops resulting in food insecurity.

4.2.2 Temperature Patterns

Both men and women lamented of increased temperatures than was previously experienced. High temperatures are observed even in months that were previously cold. For instance, the months of September, October and November were in the past associated with hot temperatures in most parts of Malawi, but these days even the months of December and January are as hot as October. The discussions also observed that the cold weather experienced in May, June and July is different from what was previously experiences. These months are too cold now than they were in 1980's and 1990's.

4.2.3 Wind Patterns

The findings from group discussions showed that there are strong winds that are experienced these days. These winds destroys crops and houses. It was observed that such winds were not experienced in the past. The discussions also revealed that in the past there was a relationship between wind and rainfall patterns. People would tell from the way the wind is blowing and the direction where it is coming from whether they will have good rains, heavy rains or shower rains. But these days, wind is just blowing anyhow and people cannot predict rainfall.

4.2.4 Soils

Men and women groups reported that they have recently observed soil degradation and this is a sign of climate change. There has been a lot of soil erosion as a result of too much rainfall and flush floods especially in low lying areas.

Soil fertility depletion was also mentioned in the discussions where farmers indicated that in the past, they used to grow maize without applying fertilizer but these days, they do not harvest any grain yield if fertilizer is not applied. This decline in soil fertility can be attributed to nutrient mining overtime through harvestable grain (e.g. maize grain) without addition of nutrients in the cropping systems; and high rates of mineralization of organic matter associated with high temperatures in these areas. For cereals such as maize, the requirements for nitrogen and phosphorus are too high and hence resulting in net negative balance of nutrients flows in farming systems. Another reason for the low yields of maize in the recent years be attributed to high adoption of improved maize varieties with high nutrient requirement compared to local maize. From this study, we also found that over 65% and 75% the farmers in Balaka and Ntcheu district respectively grow hybrid maize.

4.3 Cropping systems and soil management

4.3.1 Cropping systems

Table 4.2 shows the main crops grown by the respondents in Balaka and Ntcheu by gender. The major crops grown in the two districts are maize (*Zea mays)*, groundnut *(Arachis hypogea)*, fish bean (*Tephrosia*), pigeonpea *(Cajanus cajan)* and cowpea (*Vigna uguiculata*). Maize is sole cropped if planted at 1 seed/station x 25cm between planting stations or and intercropped with pigeonpea or cowpea or sorghum at low density. The findings have shown than a majority of farmers (72%) grow hybrid varieties such as SC403 (Kanyani), DK8053 and SC627 (Mkango). However, local maize variety is still grown by 28% of the farmers because of adaptation to low soil fertility and flint grain characteristics. Groundnut is usually sole cropped. Cotton is either sole cropped or strip intercropped with pigeonpea or cowpea. Soybean was mentioned as a new crop in Balaka district during the FGDs and is currently grown by a few farmers. In the sample, all households reported growing maize in both districts. While groundnut was a main crop for around a quarter of the sampled households in Ntcheu, it was reported by 21 percent of the sampled households in Balaka as a main crop. One surprising finding of the study was the relatively high prevalence of fish bean adoption, an important agroforestry technology among the sampled households, especially in Balaka. By national standards, the proportion of households that reported growing fish bean in the two districts is high. An analysis of the main crops grown shows that there are no significant differences in the main crops grown by the gender of the household head (Figure 4.2) with a trend of more female headed households growing groundnut.

Table 4.2: Main Crops Grown (Percentage of Sampled Households) by District (Multiple Response)

Crop	Balaka N=61	Ntcheu N=59
Maize	100.0	100.0
Cowpea	9.8	15.3
Groundnut	21.3	27.1
Pigeonpea	3.3	5.1
Cotton	14.8	3.3
Fish bean	24.6	11.9

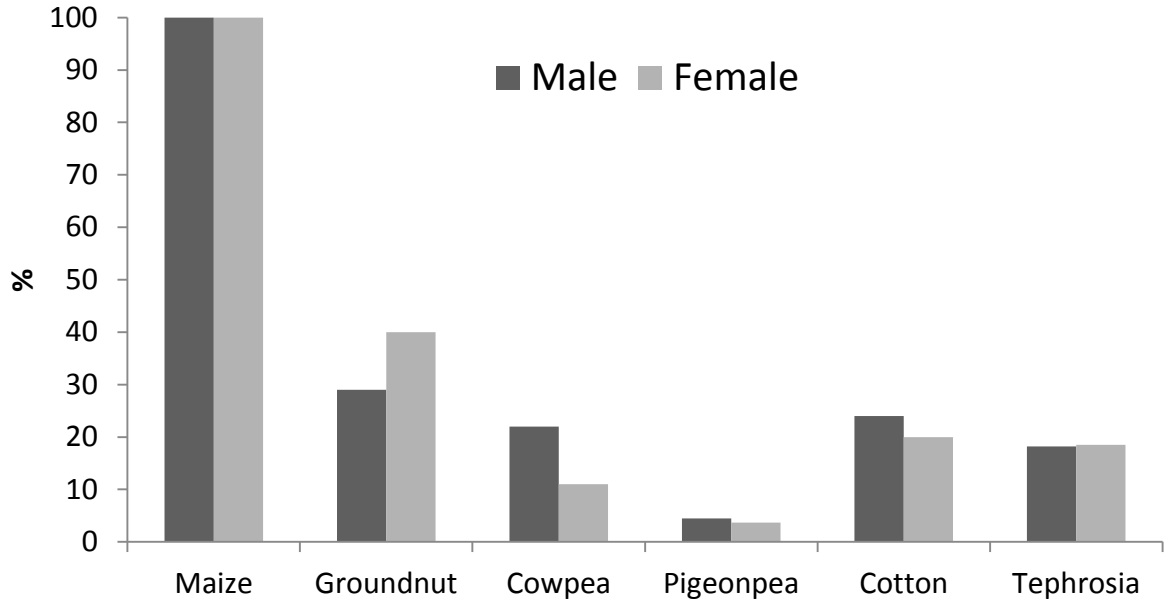

Figure 4.2: Main Crops Grown (Percentage of Sampled Households) by Gender of Household Head (Multiple Response)

4.3.1.1 Cropping systems for maize

There were two types of cropping systems of maize that are prevalent among the sampled households. Overall, around 44 percent reported using a sole cropping system, while the remaining 56 percent reported intercropping at low density. A further analysis of the cropping systems by district shows that there are no significant differences in the proportion of the sampled households that used different cropping systems between the two districts (Figure 4.3). The main types of intercrop systems were row intercropping at low density and strip intercropping. The main intercropping involved maize with pigeonpea or cowpea. Strip intercropping of cotton with either pigeonpea or cowpea was practiced by some farmers as pest management strategy whereby the pests of the two crops are controlled by pesticides sprayed in the cotton strips.

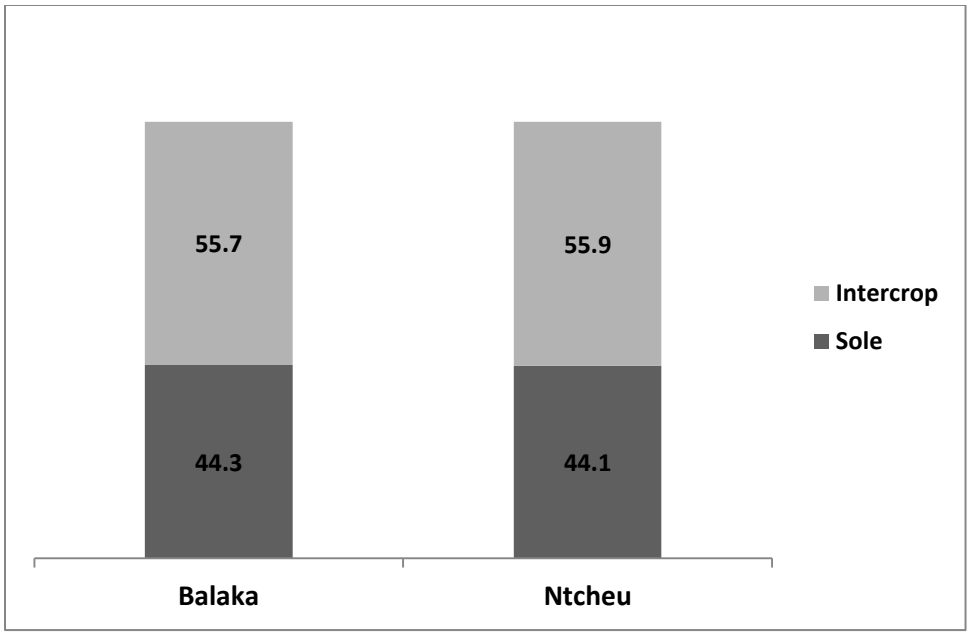

Figure 4.3: Cropping Systems by Districts (Percentage of Respondents)

4.3.1.1.1 Determinants of Cropping System

This study also analyzed factors that determine the choice of a maize cropping system. The only cropping systems reported by the farmers included sole cropping (reported by 44 percent of the sampled farmers) and intercropping at low density (reported by the remaining 56 percent). It was expected that the choice of a maize cropping system would be influenced by household level factors (such as age of the household head; gender of the household head, household land size, etc.), institutional factors (such as whether the household head is a member of a farmer group; access to agricultural extension services, etc.), and community-level factors (such as the frequency of droughts in the communities, etc.).

The logistic regression results showed that among the various determinants of the choice of maize cropping system, it was only household landholding size that was significant. However, the result showed that landholding size increases the likelihood of intercropping at low density over sole cropping. This can be attributed to the type of intercropping (strip intercropping) widely practiced in Balaka. Strip intercropping requires more land than row intercropping. Farmers who planted cotton with either cowpea or pigeonpea in strip intercropping indicated that this was mainly for pest management in which the legume benefits from the pesticides sprayed to cotton. Although this result was significant, it is not consistent with our *apriori* understanding that households that have less land are more likely to intercrop than their counterparts. A closer look at the landholding size variable shows that it ranged from 0.40ha to 2.4 ha, with a mean of 1.03ha. This result could have been influenced by the relatively small sample size (120 farmers) and it requires further investigation.

Most of the household characteristics retained their expected signs, although the results were not significant. For example, the results show that the higher the number of household members who provide farm labour reduces the likelihood of intercropping. Further, the age of the household head increases the likelihood of intercropping. One of the institutional factors that were considered in this

model – access to extension services – retained the expected sign although the result was not significant. In particular, it shows that access to extension services increases the likelihood of intercropping. On the other hand, membership to farmer organization did not retain the expected sign, although the result is insignificant. The Hosmer and Lemeshow Test was used in the analysis to test the null hypothesis that there is a linear relationship between the explanatory variables and the log odds of the dependent variable, choice of cropping system. The results shows that the χ^2 test was insignificant indicating the data fit the model well.

Maize variety in Balaka and Ntcheu districts by gender

Table 4.3 shows results on maize varieties grown by farmers by gender. The findings show that more (60-88%) farmers are growing hybrid maize. The main source of seed was the Malawi Government Subsidy program (FISP), a targeted input program that provides improved seed of maize and selected legumes; and inorganic fertilizer to the poorest farmers and vulnerable groups (Dorward and Chirwa, 2011; Malawi Government, Ministry of Agriculture and Food Security, 2010/2011). Results of the survey have shown that most farmers in the study areas grow SC403, an early maturing hybrid maize variety (120-130 days) adapted to low altitude agro-ecological zones. Other hybrid varieties grown were DKC8053 and SC627 (Mkango). Another possible reason is that if farmers purchase seed from the market, local varieties are not available. The market sells only hybrid maize or open pollinated varieties and these can be recycled for 3 years. There were no differences in maize varieties grown by the two gender groups in Balaka. However, in Ntcheu, a higher proportion of male-headed households reported growing hybrid maize than their female counter-parts. One possible explanation is the difference in household income levels between male- and female-headed households which influences their ability to access hybrid maize. We further note that the difference in hybrid adoption between male and female-headed households was significantly higher in Ntcheu than in Balaka and this can be attributed to proximity of agro-dealers in Ntcheu. Another possible explanation could be related to the low productive potential of hybrid maize in Balaka district (2.8 ton ha^{-1} vs 4.1 ton ha^{-1} of maximum yield of hybrid maize) and hence the risk and inputs costs may be higher than returns under unfavorable weather conditions. We also found that 28% of the farmers reported growing local maize because of grain quality (flint grain characteristics, and flour) and adaptation to low soil fertility.

Maize yield: The estimated yield of maize ranged from 0.12-2.78 t ha^{-1} in Balaka district, mean= 0.87±0.623 t ha^{-1}. In Ntcheu, the yield of maize was highly variable (0.099-4.12 t ha^{-1}) and mean of 1.19 ±0.964 t ha^{-1}. In both districts, lower yields were obtained from local maize (0.65 and 0.68 t ha^{-1}) compared to hybrid varieties, 0.99 and 1.34 t ha^{-1}, for Balaka and Ntcheu respectively. The yields of local maize are within the expected values under smallholder farms in Malawi. However, the average yields of hybrid maize are lower than the national average of 2.0 t ha^{-1} (MoAFS (2012). Analysis of maize yield by gender showed no significant differences between female and male farmers. However, in Ntcheu, a trend of slightly higher yield of hybrid maize for FHH than MHH was reported (Table 4.5). The opposite trend was observed in Balaka with average yields of 1.12 and 0.86 t ha^{-1} for the MHHs and FHHs respectively (Table 4.4).

Table 4.3: Maize variety grown in Balaka and Ntcheu districts by Gender, (Percentage of Sampled Households)

District	Variety	Male	Female	N
Balaka	Hybrid	61.8	69.0	63
	Local	38.2	31.0	
Ntcheu	Hybrid	87.5	68.0	57
	Local	12.5	32.0	

Table 4.4: Estimated yield (Mt ha^{-1}) of maize in Balaka and Ntcheu by Gender

District	Variety	Male	Female	N
Balaka	Hybrid	1.12 (0.138)	0.85 (0.166)	37
	Local	0.59 (0.125)	0.75 (0.201)	22
Ntcheu	Hybrid	1.24 (0.192)	1.52 (0.286)	41
	Local	0.67(0.233)	0.68(0.131)	12
All	Hybrid	1.19 (0.123)	1.17(0.168)	78
	Local	0.60 (0.107)	0.72 (0.129)	34

Yield estimated by farmers from survey data. Number in parenthesis is standard error of mean.

4.3.2 Soil Fertility Management

In the face of climate variation, the ability of the soil to provide sufficient nutrients to ensure effective crop production is an essential way of fighting food insecurity, especially in the drought-prone areas of Ntcheu and Balaka districts. The sampled households were therefore asked about the various soil fertility management practices that they undertake. The results presented in Figure 4.4, shows that inorganic fertilizers, compost manure, crop residue incorporation and integrated soil fertility management involving a combination on inorganic and organic fertilizers are common practices used by the smallholder farmers. The results further shows that the use of inorganic fertilizer was reported by a higher percentage of male-headed households (50 percent), compared to their female-headed counterparts (35.2 percent). The inorganic fertilizer is applied to maize (43.3%). This finding is consistent with our expectation as male-headed households reported a higher annual income (MWK 73,775) than the female-headed households' annual income (MWK62,836). Since less female-headed farmers have economic access to inorganic fertilizers, they mostly rely on using compost manure, incorporating crop residues and agroforestry (see Figure 4.6). Other soil fertility management options in maize and companion crops in the intercrop are use of compost manure (31.7%), crop residues (18.3%) and agroforestry (6.7%). In groundnut, 12% of the farmers incorporate crop residues to improve soil fertility.

4.3.3 Type of Extension advice on crop production

Farmers were accessing information on cropping systems from a range of sources. In Balaka, the extension providers included Government Extension System, friends, Blantyre Synod (church), and Concern Universal. The type of information include CA, single hill spacing of maize at 25cm apart, ridge spacing, crop intensification in space, timely practices of field activities, improved varieties and ISFM through integration of legumes in farming systems.

Access to agricultural extension services is very high among the sampled farmers, with 82 percent reporting having access to extension services. Figure 4.5 shows the main sources of extension services that the sampled farmers reported using. In both Balaka and Ntcheu, the most important source of extension service is the government agricultural extension workers who are resident within the communities. In both districts, government extension staff are complemented by radio, which is the second most important source of agricultural extension messages for the farmers. Further, in Ntcheu around 19 percent reported accessing agricultural extension messages from extension workers who are not employed by the government. This finding is significant because it shows that households use a

range of sources of agricultural extension messages. Therefore, agricultural extension messages that relate to improving the capacity of farmers to adapt to climate variation in these two districts should focus on using the government extension workers and the radio. In Balaka, the other extension providers were Blantyre Synod (church), and Concern Universal.

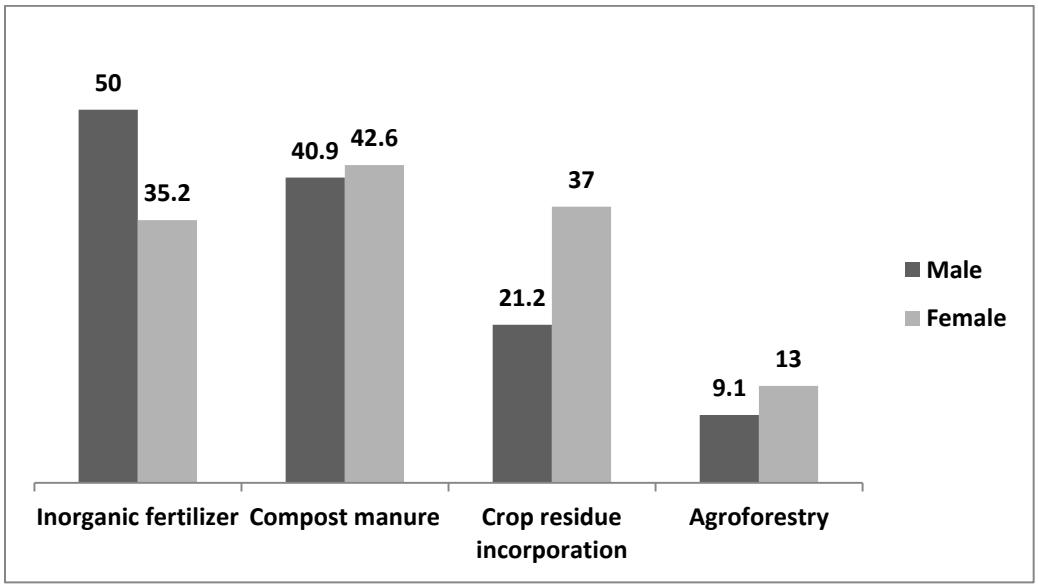

Figure 4.4: Soil Fertility Management Practices Reported by Sampled Farmers (Percentage) (Multiple Response

4.3.3**.1 Demand driven extension advice: what do the farmers want?**

In Balaka farmer were more demanding financial services and input access rather than technological knowledge. On financial side, the request was for money to buy fertilizers and herbicides and all other inputs. Technically, they felt that conservation agriculture was a good system for mitigation against climate change but adoption was hindered by the cost of herbicides and inorganic fertilizer. In Ntcheu district, farmers demanded varietal trials on crops adapted to the low altitude agro-ecological zone such as cotton varieties.

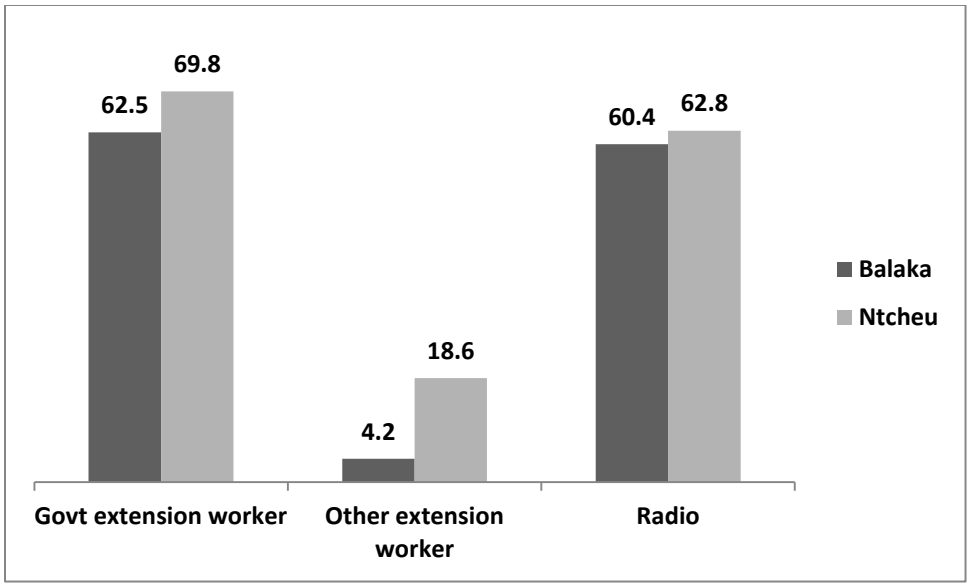

Figure 4.5: Sources of Agricultural Extension Messages for the Sampled Farmers (Percentage) by District

4.3.4 Constraints to crop production

There are many constraints that reduce the capacity of farmers to increase their crop production. In this study, respondents were asked about the main constraints that they face. The results show that the main constraints to increased crop production include lack of access to agricultural inputs. Although the Malawi Government is implementing a Farm Input Subsidy Program (FISP), which provides subsidized maize seed, legume seed and inorganic fertilizer to poor, resource-constrained farmers, it was reported through the various focus group discussions that the majority of the respondents were not beneficiaries of the FISP. As a result, access to agricultural inputs remains a very big challenge in both Balaka and Ntcheu. It is therefore not surprising that 39 percent of all the respondents in Balaka, and 49 percent of all the respondents in Ntcheu reported lack of access to farm inputs as one of the main constraints (Figure 4.6). Another important constraint to increased production reported by the respondents is erratic rainfall. In Balaka around 38 percent of the sampled households reported it as an important constraints and the proportion was even higher (42 percent) in Balaka. Discussions with key informant interviews, as well as information from focus group discussions indicate that prolonged dry spells, late onset of rainfall and early cessation of rainfall are prevalent in the communities that were part of the study. Erratic rains were mentioned as challenges in production of maize and cotton.

4.3.5 Cropping systems for adaptation to climate change

The cropping systems that farmers use for adaptation were captured in both FGD discussion and through the questionnaires. Changes in the cropping system to respond to changes in rainfall regimes have been common among the sampled farmers in both districts. In particular, 62.3% and 81.4% reported changing their cropping systems in Balaka and Ntcheu, respectively. The main changes relate to the changes in the practice of growing crops, as well as using more drought-tolerant crops (Table 4.5). As the figures show, the main important change has been a shift from using local maize varieties to using hybrid maize, reported by 49 percent of the sampled farmers. Another significant change has been changing the way maize planting is done. Around 13 percent of the sampled farmers reported changing from planting three maize seeds per station to planting of 1 seed x 25cm.

In Balaka, farmers either adopted a new system altogether or changed the methods or technology being used. For example, farmers reported changing from local or long maturity local (unimproved) varieties of pigeon pea, maize and groundnut to shorter maturing types. New technologies adopted included Conservation Agriculture (CA), box ridges, agroforestry and crop diversification. For crop diversification, farmers reported planting more of drought resilient crops such as cassava and sweet potatoes. Farmers also reported that they have moved more towards good agricultural practices such as early planting, correct ridge spacing. Table 4.5 is a summary of changes in cropping systems due to climate variability.

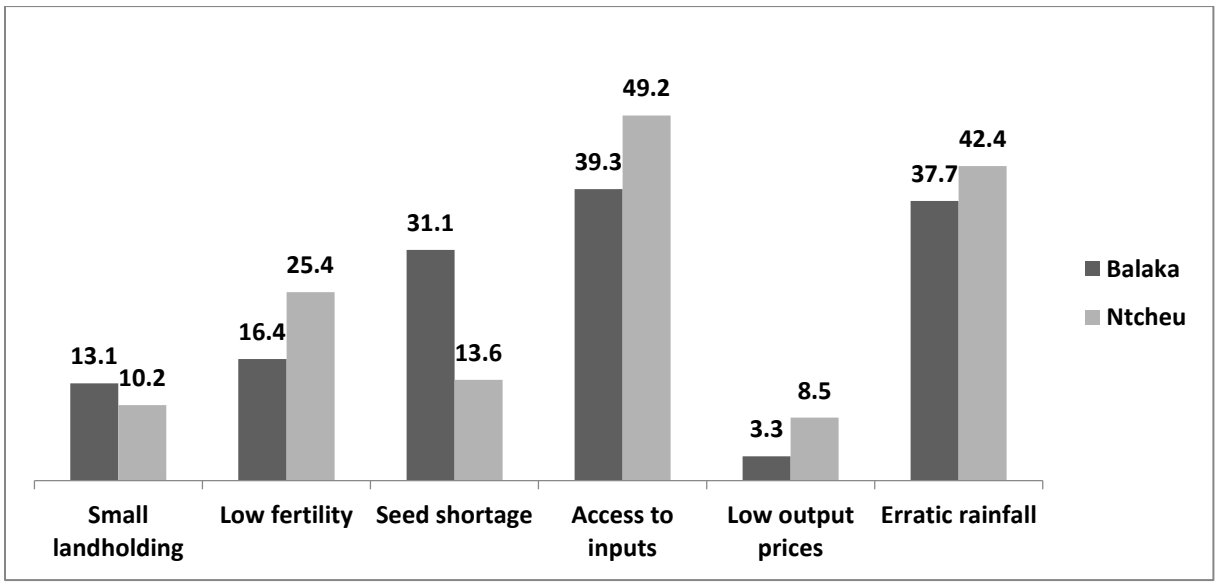

Figure 4.6: Main Constraints to Increased Crop Production (Percentage of Respondents) by Districts)

This information was corroborated from focus group discussions where farmers reported that traditionally farmers in Balaka and Ntcheu would plant as late as December but still be able to harvest enough maize. However, nowadays the onset of the rainfall season has become so unpredictable that farmers prefer to just plant their maize seed even before the onset of the first rains. Further, farmers reported that the rainfall duration has become very short due to late onset and early cessation of rainfall. It was further reported farmers have now moved into producing early maturing varieties of crops to ensure that they respond to the short rainfall duration.

Farmers were also asked to indicate their perceptions on effective cropping systems for adaptation to short rains and dry spells. The three main strategies for adaptation to short rains or dry spells were planting early maturing varieties (35%), conservation agriculture (CA) (38%) and sole cropping (34%) (Table 4.6). However, few farmers (9%) planted early maturing varieties because of high cost of improved seed. Differences were observed among the two gender groups in terms of perceptions on CA and sole cropping. Lower proportion of FHH (29%) than MHH (46%) cited CA practices as an effective strategy and this could be attributed to labor demands for CA practices and herbicides which might be limiting for most FHH. Another interesting finding was that more MHH (40%) than FHH (29%) mentioned that sole cropping was more effective for drought adaptation. This could be attributed to interspecific competition for water under drought conditions. An earlier study by Mhango et al., (2011) reported that

under drought conditions, intercropping (legume-legume or cereal-legume combinations) reduced the total biomass production compared to sole cropping.

Table 4.5: Changes in the Crop Production Practices Due to Climate Variability (Percentage of Respondents).

Practice before changes in Climate	Practices Now due to Climate Variability	Percentage of Farmers Reported
Planting of the local maize variety	Planting of hybrid maize	49%
Early planting around October	Late planting around December	7.5%
Planting 3 maize seeds per station	Planting 1 maize seed per station spaced at 25cm apart	13.4%
Planting of late maturing varieties of crops	Planting of early maturing varieties of crops	9.3%
Burning of crop residues during land preparation	Incorporation of crop residues	10%
Growing maize as the only staple	Growing drought tolerant crops, such as sorghum to supplement the maize	8.9%
Growing crops using traditional methods	Use of box ridges in crop fields	6.7%

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Table 4.6: Farmers' perceptions on effective cropping systems for adaptation to climate change

Event	Cropping systems	MHH (%)	FHH (%)	Mean (%)
Short rains	CA	45.9	28.6	37.5
	Early maturing varieties	35.1	47.5	40.3
	Box ridges	6.1	7.4	6.7
	Intercropping	2.7	11.4	6.9
Dry spells	Early maturing varieties	20	28.6	33.3
	Sole cropping	40	28.6	34.3
	Intercropping	20	28.6	25.0

CA=conservation agriculture

4.3.6 Constraints to adoption climate change mitigating cropping systems and other measures

Farmers highlighted labour, poor cash base, and unpredictable rainfall as some of the main challenges to implementing integrated soil fertility management technologies. On labour, famers gave example of compost manure which is labour intensive to prepare and apply in the fields. They also indicated that household is not enough to meet their farming requirements. In connection of a low incomes, farmers indicated that they low incomes to enable to buy inputs such seeds of improved varieties and other inputs, which were constraints to crop diversification. Also, low incomes compel farmers to work elsewhere for cash at the expense of their own fields during critical periods.

Chapter Six
CONCLUSION

It can be concluded that farmers are aware and responding to climate variability. Technologies used for mitigating effects of climate variability are being used by all farmers to some extent. It is recommended that studies are conducted with long time term weather data to determine whether climate change has existed, and indeed if the calendars of events such as planting dates may need to be adjusted. Other variables to be established would include rainfall duration and the duration of mid-season dry spells. While extension agents are facilitating with technological options that adapt to climate variability, we recommend two approaches to empower farmers 1) empower farmers with knowledge for context-specific decision making 2) improve capacity of farmers to access appropriate inputs. The current situation is that of heavy dependency on non-governmental organizations and other development agents. Supply of inputs is untimely, and in some cases wrong type of technologies (eg non adapted varieties) brought to farmers apparently just so that the projects can record success. By empowering farmers with knowledge and buying power, farmers may exert demand of products and buy appropriate inputs.

Even though there are differences in annual incomes, adaptation strategies to climate variability, and use of improved maize varieties in Ntcheu between the MHH and FHH, there seems to be a balance in terms of gender access to agricultural inputs, choice of cropping systems and productivity of maize based systems. Further studies are recommended to assess the determinants of this change and effects of empowering women on productivity of agricultural systems and household food security.

A PLAN FOR CONTINUATION OF THE RESEARCH AND IDENTIFICATION OF EXTERNAL FUNDING AGENCIES YOU INTEND TO APPLY TO

There is growing recognition of declining soil fertility and climate change and climate variability as major issues constraining agricultural productivity, particularly amongst small scale farmers. The Integrated Soil Fertility Management (ISFM) approach is considered as best way to advance soil fertility in small farmers fields (Sanginga and Woomer, 2009). This is the case in Malawi, evidenced by Farm Input Subsidy Program (FISP), which supports legume seeds and inorganic fertilizer use. The scientists in this proposed project are collaborating in research on use grain legumes to enhance soil fertility amongst small scale farmers supported by various donor partners, such as McKnight Foundation, AGRA. One of our strategies for continued funding will be to re-design the projects for the next phase of funding, so that they incorporate issues of climate variability. Other donors include the LUANAR-CABMACC (Capacity Building for Climate Change Adaptation), Regional Universities for Africa (RUFORUM), which also announces post-graduate related research grants. The team is currently polishing the proposal to take the next opportunity to seek support on research that understands and predicts response of crops under inorganic/organic fertility amendment when complexed by varying degrees of drought incidences. Further, the team members are active members of the Soil Health Consortium of Malawi and intends to disseminate the output and improve scope for funding through the consortium. The team will generally look out for calls, including those by LUANAR-CANMACC, Bill and Mellinda Gates Foundation Millennium Projects, START Grant Awards for Global Environmental Change Research.

POTENTIAL FUNDING AGENCIES FOR FUTURE PROJECT FUNDING

a) Lilongwe University of Agriculture and Natural Resources, CABMACC
b) Regional Universities for Africa (RUFORUM)
c) START Grant Awards for Global Environmental Change Research in Africa
d) Mc Knight Foundation Collaborative Crop Research Program
e) Alliance for Green Revolution in Africa (AGRA)
f) Bill and Mellinda Gates Foundation Millennium Projects

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USAID-FUNDED PROGRAM: AGRO-ECOSYSTEMS SERVICES – LINKING SCIENCE TO ACTION IN MALAWI AND THE REGION

NARATIVE END OF PROJECT REPORT
PROJECT TITLE: EVALUATION AND PROMOTION OF THE USE OF PESTICIDAL PLANTS AMONG SMALLHOLDER FARMERS IN MALAWI

1.0 PROJECT SUMMARY

Storage losses due to insect pests are a serious threat to food security and household incomes. Because of high cost of synthetic insecticides to ordinary farmers and their limited availability, small-scale farmers resort to use indigenous plant materials to control storage insect pests. This study was conducted to evaluate and validate the plant materials that are used by farmers in some parts of northern Malawi.

The main goal of our project was to increase the use of pesticidal plants among smallholder farmers in order to reduce insect crop losses of maize and beans thereby reducing the amount of persistent organic pollutants in the environment and helping to conserve biodiversity. Specifically, the project aimed at (1) consulting with local farmers to select a shortlist of indigenously used plant materials for evaluation against insect pests infesting stored maize and beans; (2) conducting bioassay to evaluate and validate the efficacy of plant material used by farmers; (3) carry out phytochemical analysis of promising pesticidal plants to determine active ingredients, and their biological activities; and finally, (4) communicate research findings via leaflets, popular press and scientific journals. However, objective number 3 was removed after the reviewers noted that the time and funds allocated for the project would not permit to conduct phytochemical analysis of the plant material and was to be taken care in the future big project.

Laboratory bioassays were conducted for selected plant materials (based on farmers' information) against adult *Sitophilus zeamais*. Farm trials were conducted in Jenda for 4 months including the first month for setting trials. The plant species that were reported by farmers included: *Azadirachta indica* (neem), *Securidaca longepedunculata* (Muuluka), Soyo (Vernonia spp.), *Tagetes minuta* and *Tephrosia vogelii*. Out of these plant species, *S. longepedunculata* (Muuluka) and *A. indica* (neem) seed kernel were the most effective against *S. zeamais* in the laboratory and field trials. Research findings were

disseminated at the conference that was organized by the Agro-Ecosystems main project at Ufulu Gardens in Lilongwe.

2.0 Project Site

The study was conducted at Jenda (Champhira extension planning area) in Mzimba District, northern Malawi.

3.0 Research Outputs

3.1 Output 1: Conduction of Inception meeting

The inception meeting was conducted at Bunda College of Agriculture, Lilongwe University of Agriculture and Natural Resources (LUANAR). All members of the project team (Mr John F. Kamanula from Mzuzu University, Dr Cecilia Maliwichi-Nyirenda from Indigenous Knowledge Centre and Mr D.P. Kafere from Bunda College of Agriculture) attended the meeting. The aim of the inception meeting was to strategize on how the project activities could be conducted. At the meeting members agreed that field trials should be conducted at Jenda due to close proximity of Mzuzu University, where the lead partner for the field trials was based.

Deliverable 1: Protocol for carrying out project activities developed.

Protocol for field trials and other project activities was developed

3.2 Output 2: Identification of pesticidal plants used by smallholder farmers

Consultation with farmers was done not as a separate activity but was done when we conducted on-farm storage trials. The reason was that the funds we had could not permit to conduct a full field survey. This was also suggested by the project reviewers.

Deliverable 1: A shortlist of pesticidal plants used by farmers in the study area was produced

Table 1 shows a shortlist of plant species/methods reported by farmers to control maize and bean storage insect pests:

Plant species/ Control method	**Local name**	**Use**	**Part of the plant used**
Securidaca longepedunculata	Muuluka	controlling maize and bean insect pests	root bark
Azadirachta indica	Nimu	controlling maize and bean insect pests	seed kernel
Vernonia spp.	Soyo	controlling maize and bean insect pests	leaves
Tephrosia vogelii	Gulinga/Mtetezga	controlling maize and bean insect pests	leaves
Tages minuta	Maluwa onunkha	controlling maize and bean insect pests	leaves
Ash	Phulusa	controlling maize and bean insect pests	
Cow dung	Ndowe zang'ombe	controlling maize and bean insect pests	

3.3 Output 3: Conduction of Insect Toxicity Bioassays was done

For laboratory bioassay experiments, we concentrated on *S. longepedunculata* root bark, *A. indica* seed kernel, *T. vogelii* leaves and *M. oleifera* because farmers reported that *S. longepedunculata*, *A. indica* and *T. vogelii* were very effective against storage insect pests of maize and beans. *M. oleifera* was not mentioned as a botanical pesticide but as a medicinal plant and as vegetable (leaves). We could not use other plant materials due to lack of time. We also did not have enough insect (*S. zeamais*).

The laboratory evaluation and validation of plant materials reported by farmers in Jenda were done at Lunyangwa Agricultural Research Station in Mzuzu, northern Malawi. *Sitophilus zeamais*, one of the economic insect pests of stored maize was cultured and new generation of known age (0-7 days old) was used for all bioassay experiments.

Effect of dry powdered *S. longepedunculata* root bark, *A. indica* seed kernel, *T. vogelii* leaves and *M. oleifera* seed kernel on adult mortality of *S. zeamais* after 14 days of exposure

Each plant material was admixed with maize grain at three different dosages (1, 2 and 5 %, w/w) in a glass vial. To each treatment, 20 unsexed adult *S. zeamais* (0-7 days old) were added and cultures left in a constant room (30 °C, 65 ± 5 % Relative Humidity). Data on live and dead insects was recorded after 14 days of exposure.

Deliverable 1: Data on efficacy of botanical pesticides used by farmers was produced.

Data on the efficacy of *S. longepedunculata* root bark, *A. indica* seed kernel, *T. vogelii* leaves, *M. oleifera* seed kernel and Actellic super dust against adult *S. zeamais* was produced.

Table 2 shows % mortality of adult *S. zeamais*, after 14 days of exposure of *S. zeamais* to different dosages of plant materials. Based on the results, *S. longepedunculata* root bark and *A. indica* seed kernel were more effective in killing adult *S. zeamais* than *T. vogelii* leaves and *M. oleifera* seed kernel. The efficacy was dose dependent.

Table 2: Effect of dry powders of *S. longepedunculata* root bark, *A. indica* seed kernel, *M. oleifera* seed kernel, *T. vogelii* leaf and Actellic super dust on adult *S. zeamais* after 14 days of exposure

Treatment	**% Mortality of adult *S. zeamais* (n=6)**
Untreated maize grain	16 ± 6
S. longepedunculata root bark 1 %	85 ± 4
S. longepedunculata root bark 2 %	85 ± 2
S. longepedunculata root bark 5 %	91 ± 1
A. indica seed kernel 1%	34 ± 8
A. indica seed kernel 2 %	68 ± 14
A. indica seed kernel 5 %	84 ± 10
M. oleifera seed kernel 1%	38 ± 6
M. oleifera seed kernel 2 %	62 ± 13
M. oleifera seed kernel 5 %	80 ± 5
T. vogelii leaf 1 %	10 ± 4
T. vogelii 2 %	11 ± 2
T. vogelii 5 %	18 ± 3
Actellic super dust (0.05 %)	100 ± 0

In another experiment, each dry powdered plant material (1 g) was admixed with maize grain (50 g) in a kilner jar (500 ml) to make a dosage of 2 % (w/w). To each jar, 40 unsexed adult *S. zeamais* (0-7 days old) were added and left in a constant room for 14 days and adult insects were sieved. The cultures were put back in the constant room until the first emergence of adult *S. zeamais* appeared and then collected (duration of 42 days). Based on the results, Actellic super dust (0.05 %, w/w) was the most effect treatment followed by *S. longepedunculata* root bark and *A. indica* seed kernel. Table 3 shows the effect of plant materials on the first (F1) emergence of *S. zeamais* after 42 days.

Table 3: Effect of dry powders of *S. longepedunculata* root bark, *A. indica* seed kernel, *M. oleifera* seed kernel, *T. vogelii* leaf and Actellic super dust on F1 emergence of *S. zeamais after 42 days*

	***S. zeamais* F1 emergence (42 days after sieving)**		**(n = 6)**
Treatment	**Total *S. zeamais* Emerged**	**Live *S. zeamais***	**Dead *S. zeamais***
Untreated maize grain	57	55	2
S. longepedunculata root bark 1 %	10	7	3
S. longepedunculata root bark 2 %	10	4	6
S. longepedunculata root bark 5 %	7	5	2
A. indica seed kernel 1%	11	7	4
A. indica seed kernel 2 %	9	7	2
A. indica seed kernel 5 %	7	3	4
M. oleifera seed kernel 1%	79	78	1
M. oleifera seed kernel 2 %	31	31	0
M. oleifera seed kernel 5 %	21	20	1
T. vogelii leaf 1 %	59	58	1
T. vogelii leaf 2 %	56	56	0
T. vogelii leaf 5 %	50	48	2
Actellic super dust (0.05 %)	9	0	9

Output 4: On-farm storage trials conducted

Effect of dry powders of *S. longepedunculata* root bark, *A. indica* seed kernel and mixture of *S. longepedunculata* root bark +*A. indica* seed kernel on adult mortality of *S. zeamais*

Maize storage trials were conducted in Jenda for 4 months including the first month for setting up the trials. Farmers collected the plant material, dried them under shade, pounded and sieved them (Figure 1)

Figure 1: Farmers processing plant material for storage trials.

Maize grains (10 kg) were admixed with 200 g of each of the plant material separately to make a dosage of 2 % (w/w). This dosage was the one that farmers reported to have been using. Data on damaged grains, undamaged grains and number of insects was collected every month for a period of 3 months from the date of trial set-up.

Based on our results, the mixture (1:1) of *A. indica* seed kernel and *S. longepedunculata* root bark powders (2 %, w/w) was the most effective in controlling *S. zeamais*, followed by *A. indica* seed kernel and *S. longepedunculata* root bark powders (Figure 2). After 3 months of storage, maize grain treated with the mixture reduced grain damage from 54 % in the untreated maize grain to 21 % in the grain treated with the mixture. *A. indica* seed kernel and *S. longepedunculata* root bark powders caused 29

and 31 % grain damage, respectively compared to 54 % damage in the untreated maize. There was no significant (*P*>0.05) difference in grain damage between maize grain treated with the mixture (1:1) of *A. indica* seed kernel and *S. longepedunculata* root bark powders and maize grain treated with *A. indica* seed kernel and *S. longepedunculata* applied separately.

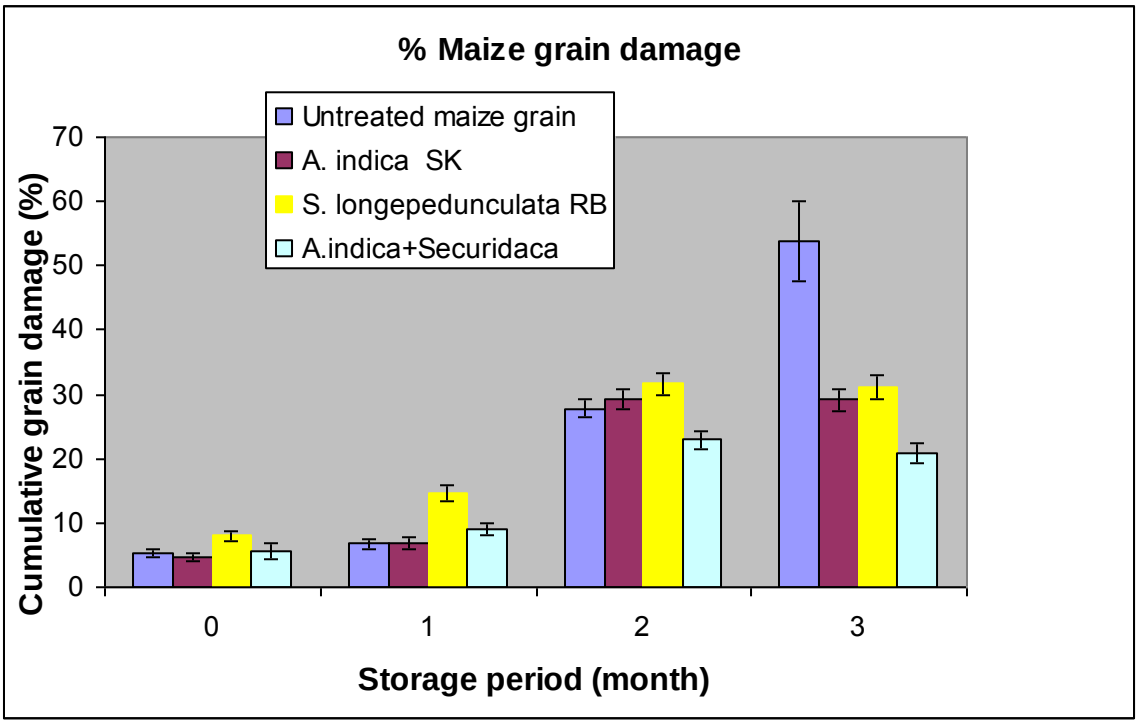

Figure 2: Efficacy of the mixture of *A. indica* + *S. longepedunculata* root bark, *A. indica* seed kernel and *S. longepedunculata* root bark powders against *S. zeamais*.

Output 5: Dissemination of research findings

Deliverable 1: A paper on the research findings was presented at the conference which was organized by the **AGRO-ECOSYSTEMS SERVICES – LINKING SCIENCE TO ACTION IN MALAWI AND THE REGION** at Ufulu Gardens in Lilongwe.

4.0 Conclusion

This research project ha evaluated the efficacy of some of the plant species used by farmers in Jenda, Mzimba District. Results have shown that *A. indica* (neem) seed kernel and *S. longepedunculata* (Muuluka) root bark powders are effective in controlling maize storage insect pests, such as maize weevils (*Sitophilus zeamais*) under laboratory and field conditions. Application of a mixture of neem seed kernel and Muuluka root bark (1:1) powders slightly increased the efficacy against the test insects (*S. zeamais*).

4.0 Limitations of the Study

Due to limited time and funds, phytochemical analysis, safety and shelf life studies of the plant materials have not been done.

5.0 Plan for research continuation

We have written and submitted a proposal to PEER Science round 3 and we are waiting for the feedback. We will continue writing proposals for possible funding to continue the activities that have not been covered in this project, such as phytochemical analysis of promising pesticidal plants, temporal and spatial variations in the plant chemistry and their shelf life and longevity with respect to impact on efficacy and use; conservation and propagation of promising botanical pesticides.

If we get funding we will continue with on-farm storage trials in all the three regions of Malawi (southern, central and northern Malawi). In addition, we will investigate the efficacy of plant extracts against storage insect pests of maize and beans. We will also investigate the efficacy of new plant species that have not been reported by smallholder farmers in the study area but farmers in other countries are using them as botanical pesticides, for example, pyrethrum.

ASSESSING SUSTAINABLE LIVELIHOODS THROUGH NATURAL RESOURCE MANAGEMENT IN FLOOD PRONE AREAS – A LINK TO CLIMATE CHANGE RESILIENCE

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ACKNOWLEDGEMENTS

The lead investigator is grateful to Usaid-Funded Program: Agro-Ecosystems Services (AGESS) – Linking Science to Action in Malawi and the Region Country Project Coordinator Dr Daimon Kambewa and the entire AGESS team (MSU, LUANAR, UNIMA and LINCOLN University), for their support and seed grant to assess sustainable livelihoods through natural resource management in flood prone areas of Nsanje.

The research team is also grateful to many stakeholders (Government and Non Governmental) that were consulted in this study. Although no prior arrangements were made for our visits but we were overwhelmed by the hospitality, active participation and fruitful discussions by all the stakeholders consulted.

AFFIRMATION

This is to affirm that this document has been produced by a reseach team investigating on a research project titled “Assessing Sustainable Livelihoods Through Natural Resource Management in Flood Prone Areas of Nsanje – A Link to Climate Change Resilience”

The study described herein consists of our own work, undertaken during the assessment and all secondary work has been professionally acknowledged.

Francis Maguza-Tembo
Lead Investigator
April 2014

EXECUTIVE SUMMARY

This report presents a summary of the main results of the analysis of the study that was carried out between October 2012 to March 2013 in 18 villages, with 146 households, in Traditional Authority Mbenje in Nsanje district. The majority of People in the area have primary education. About 54.8 percent have primary education, 36.3 percent have no any formal education and those with secondary education were only 8.9 percent. On food production, the vast majority of households in Nsanje produce food crops and rely on farming for their income. Most of the crops produced are consumed by the family members themselves, as few households sell their agricultural produce. Generally, sorghum and millet were the two most important crops in this area, and they are being grown because they are drought tolerant. Only 6.2 percent of households are food secure meaning that they have food throughout the year while the 93.8 percent experience difficulties in feeding their families. On natural

resources management, people in this area are do not protect their natural resources. Further, people do only concentrate on tree planting without conserving the soils.

The study noted that most people are involved in casual labour mainly during the months of October to January when they have little food in their household. Casual work such as offering themselves for farm labour on other peoples' gardens or fields; transporting farm produce to the market, and transporting natural resource-based products such as charcoal, firewood, poles or timber either to the markets or to the homesteads; Selling of fuel-wood; Doing other petty businesses such as baking scones, beer brewing and distilling, and embroidery

The flooding and drought conditions have also contributed to increased poverty levels amongst the households in the district.

Crops grown

Sorghum and millet are the main food crops in the district seconded by maize and sweet potatoes. On the other hand, cotton is the main cash crop in the district. However, sweet potato also plays as a cash crop in the district. These crops can easily be grown under small-scale or large-scale irrigation hence food insecurity problems would not be a serious issue.

Coping Strategies

Natural resource-based coping strategies in times of food shortage are the commonest and cheapest in the area of study. The major coping strategies are:

a) Eating wild fruits mainly Tamarind species (*Bwemba)* and Adansonia species (*Malambe)* and *Nyika* (wild root tuber);

b) Selling firewood and charcoal are other strategies for raising money.

c) Selling of Livestock and their products. The district has the highest potential of livestock production but limited veterinary and livestock extension services are some of the impediments to increased livestock production in the districts.

d) Theres is no fish Farming in the area but community members rely on natural fish sources.

Major disasters experienced in the districts

Dry spells and droughts are common in the district, but other major disaster is flooding. These have adverse effects on the livelihood systems of the communities as frequent flooding and droughts makes people in the area to rely on handouts.

Challenges to high crop production

The common challenges to high crop production in the area include:

a) Erratic rains: rains are unreliable in the area.

b) Little time given to own crop management. Due to perpetual food shortages in the area, people spend most of their time doing casual work in other people's gardens for the immediate food needs for the household. People even go across the border into Mozambique where they stay for about a week doing piece work. Usually the husband and the wife do exchange in such circumstances while other families completely move out of their villages together with the children to work as labourers or tenants in Mozambique.

c) Floods: This is one of the most difficult phenomena affecting crop production in the district.

d) Drying up of streaming and swamps like the Dinde Marsh: The low water table affect the availability of residual moisture for growing crops

e) Pests: Community members say that pests such as termites, grasshoppers, ants and stalk borer are a menace to maize, sorghum and millet. In the Mwabvi ecosystem, monkeys and bush pigs destroy crops.

f) Belief in *Mbona* a traditional goddess: Other community members allude to the erratic rainfall that they get to failure by traditional leaders to offer sacrifices to the traditional goddess *Mbona*.

g) Weak financial base lendering people in the district to fail making the best use of waters from the Shire River and the Marshes for irrigation farming.

h) Some soils are saline and these hamper crop growth;

i) Use of traditional farming systems as some people believe that their soils are fertile and that synthetic fertilizers scotch the soil, therefore they do not see the need to apply these fertilizers.

Opportunities to high crop production

Despite the many challenges that limit crop production in the district, the study found out that there are some favourable conditions that are a prerequisite for high crop production. These conditions include;

a) Ferrallitic soils in the rift valley which are favourable for high production of crops such as maize, tobacco and groundnuts.

b) High temperatures coupled with the fertile soils that are favourable for fast growth and maturity of crops if the right varieties are grown,

c) Availability of extension workers, though limited to the rift valley floor, both government and non-governmental organizations' extension workers are hard working.

d) Availability of water throughout the year in some areas of the district.

e) Existing opportunities for water harvesting which can improve water availability for irrigation

ACRONYMS

ADD	Agriculture Development Division
ADMARC	Agriculture Development and Marketing Corporation
AIDS	Acquired Immune Deficiency Syndrome
DC	District Commissioner
DDB	District Data Bank
DDP	District Development Plan
DDPF	District Development Planning Framework
DEC	District Executive Committee
DEM	District Education Manager
DPD	Director of Planning and Development
DPS	District Planning System
DEMAT	Development of Malawian Enterprises Trust
EPA	Extension Planning Area
ESCOM	Electricity Supply Commission of Malawi
GVH	Group Village Head
IGA	Income Generating Activity
IRRAP	Integrated Rural Accessibility Planning
MACOHA	Malawi Council for the Handicapped
MASAF	Malawi Social Action Fund
MCP	Malawi Congress Party
MGDs	Millennium Development Goals
MHC	Malawi Housing Corporation
MPC	Malawi Postal Corporations
MTL	Malawi Telecommunication Limitation
MRFC	Malawi Rural Finance Company
M&E	Monitoring and Evaluation Officer
NABW	National Association of Business Women
NGO	Non-Governmental Organization
OPC	Office of the President and Cabinet
RDP	Rural Development Programme
SEDOM	Small Enterprise Development of Malawi
SME	Small and Medium Enterprises
SRWB	Southern Region Water Board
TA	Traditional Authority
UDF	United Democratic Front
UNDP	United Nations Development Programme
VAP	Village Action Plan
VDC	Village Development Committee
VG	Village Head

1. INTRODUCTION

A study on assessing sustainable livelihoods through natural resource management in flood prone areas – a link to climate change resilience in Nsanje was done between October 2012 and April 2013 to (1) Assess the ecological impact of floods on livelihoods by reviewing national and district documentation on the ecological impact of floods in Nsanje, (2) Evaluate livelihood opportunities that exist in flood prone areas by identifying stakeholders' assessment and alternative livelihood strategies of people of Nsanje, (3) document appropriate livelihood opportunities; (4) develop appropriate habitat restoration and sustainable natural resource management measures; (5) document lessons from pilot projects to guide replication and adaptation by wider community; and (6) make policy recommendations to government institutions and communities. Detailed research activities did focus on flood prone areas of Nsanje in the Southern Region of Malawi.

- **Climate variability in Malawi**

Climate change is a major global threat. Over the last century, global temperatures have risen by 0.7°C. Sea levels are rising at three millimetres a year and Arctic sea ice is melting at almost three per cent a decade. Continued warming of the atmosphere at the same rate will result in substantial damage to water resources, ecosystems and coastlines, as well as having an impact on food supplies and health. A large number of other climatic changes have also been observed, including: an increase in the global area affected by drought; more frequent heat waves over most land areas; increased heavy precipitation events over most land areas; an increased incidence of extreme high sea level worldwide. These climatic changes have adverse negative effects in countries that depend directly on natural resources for livelihood.

Malawi is heavily dependent on natural resources, mainly soils, water, fisheries from inland lakes and fuel wood from forests. These climatic changes pose a great threat to a large number of people's livelihoods. Recently, Malawi has witnessed an increase in disasters related to climate change, like floods and drought. Floods have resulted in severe crop loss, life loss, infrastructure destruction, including roads and the only rail line that links the south to the centre, resulting in serious socio-economic disruptions, food insecurity, and diseases, such as diarrhoea, cholera and malaria. Among the most flood hit districts in Malawi is Nsanje. In Nsanje all TAs, namely Chimombo, Malemia, Mbenje, Mlolo, Ndamera, Ngabu, Nyachikadza, and Tengani. are prone to floods, except Makoko. Almost each and every year, the district experiences floods which among others, it is caused by the swelling of Ruo and Shire Rivers due to heavy rains.

The climate of Nsanje district is characterized by two well defined seasons: a dry season from May to October and a rainy season from November to April. The average annual rainfall is 813mm. There is a steady increase of rainfall with increasing topographic gradient from Shire River to the Western Hills where the average annual rainfall reaches 1317mm. Temperatures fall to their lowest from June to July when they average a minimum and maximum of 13.4 and 27.4 oC respectively. October has the highest average minimum of 37.5 oC. It should be indicated that these temperatures are the highest compared to the rest of the country.

This research study at household level was carried out in March in Nsanje with 146 households intending to explore the sustainable livelihoods that people use during the flood period for their survival. The objective was to gather baseline information at household-level about some basic

indicators of welfare, information sources, livelihood/agriculture/natural resource management strategies, current risk management, mitigation and adaptation practices.

- **General Features of Nsanje**

Nsanje District is one of the thirteen districts in the Southern Region of Malawi situated at the southern tip of the country within the Lower Shire valley located 174 Km from Blantyre City which is the major commercial and industrial centre for the country and the administrative headquarters for the Southern Region. It is bordered by Chikhwawa in the North East, Thyolo in the North and the rest surrounded by the Republic of Mozambique. It has a total land area of 1,942 sq. Km.

According to the District SEP Plan the District has three major natural regions. The western part characterized by a rift valley scarp whose average height ranges from 457m within the rift valley to 914m over the Malawi Hills (Chididi Range). The range is mostly deeply dissected and is best left for watershed protection. While the Lower Shire valley is classified as the rift valley floor with an average height of 61m. The district has two marshes along Shire River namely Dinde and Elephant Marshes located above Chiromo Bridge.

- **Natural Resources and Environment**

Geology and Hydrology

A mixture of different types of rocks which include aegirine and nepheline with alluvial, colluvial with some residual deposits characterizes Nsanje District. The most predominant soils are the lithosols, which are shallow and stony occurring mainly in the rift valley scarp. Some pockets of ferrallitic soil found within this zone are suitable for intensive cultivation of maize, tobacco, and groundnuts. Alluvial calcimorphic soils which are grey brown earths occur around Elephant and Dinde Marshes along Shire River and are intensively cultivated during the dry season.

Vegetation and Forest Reserve

Nsanje has an open canopy of woodland of hills and scarps which is a particular feature of the rift valley escarpment where thin stony soils occur. It is dominated by Brachystegia species and Woodland savanna mixed species that are dominated by Brachystegia species, but further contains combretum and acaia. There are perennial wet grasslands in the wettest areas of the marshes which include *Typha australis, Vossia cuspidate, pennisetum purpurea, Cyperus papyrus* and *Echinochloa pyramidalis.*

Nsanje is endowed with forestry resources that need conserving to ensure their sustainability, availability and utilization. Forests are beneficial to the communities in the district for the following uses: firewood, building materials, medicines, protecting the environment such as soil and water, and food for livestock as well as human beings. Nsanje District has 40,395 ha of forests under gazetted forest reserves, representing 18% of the districts total land area. The period between 1986 to1993 was characterized by heavy deforestation particularly in the woody mountain areas to the west of the District due to the presence of Mozambican refugees. Deforestation resulted in serious erosion of the areas. The forestry department embarked on a forestation campaign to encourage tree planting on both communal and individuals' land holdings.

Wild Life and Game Reserve

Nsanje has one Game Reserve namely Mwabvi Game Reserve approximated to be 13 km away. The name of the reserve comes from Mwabvi River which runs through the reserve. Mwabvi is a Sena word for the tree *Erythophleum Suaveolens* commonly known as the forest ordeal tree. The tree has many

medical properties and also used as a poison causing death by heart failure. The reserve is shared by T/As Mbenje, Tengani from Nsanje District and TA Ngabu from Chikhwawa.

The reserve has an average annual rainfall of between 750 mm to 900 mm and the mean minimum and maximum temperatures of 13.2^{o}C and 27.8^{o}C respectively.

The reserve is generally composed of mosaic of dambos, thicket, *Julbernadia brachystigia*, mopane, acacia and combretum woodlands with the riverine forest along water courses (Table 1). The Reserve is extremely vulnerable to land use practices outside its boundaries as the river catchments in the south east are damaged due to poor agriculture practices of clearing of trees from steep slopes which has an impact on the conservation area.

Table 1: Mwabvi Game Reserve Vegetation Type

VEGETATION TYPE	**Area (KM^2)**
River line woodland	13
Mopane woodland	41
Dry deciduous thicket	25
Mixed closed woodland	35
Eastern uplands woodlands	12
Grasslands &open savanna	8
Riparian thicket	1

Animals, Bird Life, Fish and Rare Endangered Endemic species of the Reserve

The Reserve was originally established to protect the Black rhinoceros population but the species got extinct in the years 1989-1992. It is reported that apparently no species has grown to its carrying capacity in the past 20 years due to poaching, bushfires; habitat loss and encroachment but a few species have shown significant increase in numbers (Table 2). It has been reported in the District SEP that the reserve had plans to re-introduce animals such as, Black rhinos, lions, Zebras, Elands, Steenboks, heart beast. The SEP Report clearly stated that introduction of Elephant to the reserve was not recommended due to security concerns as the size of the reserve is small unless the whole reserve is fenced to avoid human animal conflict.

Table 2: Showing annual animal Statistics for year 2007-2008

SPECIES	**Total**
Kudu	150
Buffalo	110
Bush pig	131
Warthog	167
Common duiker	43
Sable	61
Nyala	150
Impala	438
Grysbok	29
Klipspringer	25
Bushbuck	15
Suni	12

The reserve contains the only protected populations of the double collared sand grouse and black tailed grey waxbill in Malawi. It has been reported that the decline of animals in the reserve did not affect birds' populations and the important habitats for birds are the thickets which contain some of the most northerly population of species which are essentially coastal e.g. Rudds, Apalis, wood wards, Batis and grey sunbirds.

The species Barbus choloensis is found only as an isolated population in the pools of Mwabvi gorge where it is believed to be the only occurrence of the fish in the lower shire valley. The Reserve is a host to the following rare, endangered and endemic species of Malawi; Elephant Shrew (Rhynchocyon cirnei shirensis sin), Samango monkey (Cercopitheus albogulanis), Nyala (Tragelaphus angasi), Suni (Neotragus moschatus), Double banded Sandgrouse (Pterocles bicinctus) and Relic fish (Barbus choloensis).

Land use around the Reserve

Subsistence Agriculture is the primary land use outside the reserve and the average landholding size is at 1.5 acres per household. Sorghum millet, cotton and Maize are major crops grown in the uplands during rainy season and there is little winter cropping due to lack of residual moisture in dambos as a result of inadequate rainfall. Low rainfall has made the area to have no fruits grown outside the reserve except for watermelon and cucumbers that grow well in hot areas. Cattle numbers around the reserve is relatively low but other domestic livestock such as goats, sheep and pigs are abundant. Resource utilization around the reserve is done through collection of wild fruits and grass for thatching by communities following proper channels and mostly accompanied by scouts.

Tourism Potential for Mwabvi Wildlife Reserve

Game viewing, bird watching, trail walking safaris, botanical and zoological studies, photographing and angling and walking safari are some of the facilities available for tourists. Beautiful scenery occurs in the reserve as Mwabvi River which has numerous pools overhanging in its deep shady riverine vegetation and the Mwabvi gorge on the River has steep sides that are very narrow. A relic fish population of conservation importance is available in the pools of the gorge. In sight is a Dove rock (mwala wa nkhunda) which is a free standing sandstone rock pitted with depressions which are sometimes used as sites fot birds nesting. Traditionally a story is told that the holes are manmade to obtain mineral component for gun powder (SEP, 2010).

Dove rock

Figure 1: Dove rock (mwala wa nkhunda)

Other rocks of ecotourism importance are **Nkhangane:** a rock steep sided with numerous caves and local people believe that this rock is inhabited by dead spirits; **Mwala wa Tambalala:** a very large flat

rock steep sided as one climbs on top, it gives clear game viewing especially during dry season; **Ndoleka:** Another rock which is big steep sided and has a cave whereby bees are found throughout the seasons.

Camping and Entry Fees in the Reserve

The reserve has different camping sites namely Migudu, Mwabvi and Chipembere. Visitors in the camps sleep in their own tents and bring their own food and water, only firewood and toilets are provided. Chipembere Camp is outside the reserve and this is the only place where accommodation is provided but no meals. All visitors are requested to pay park entry fees before entering the reserve and the rates are revised as necessary.

Management of the reserve

Management and protection of wild life in the reserve is more of top down management as the reserves law enforcement team from the parks and wildlife departments deploy their parks assistant that are headed by the reserve manager. It is reported that patrols are planned according to areas targeted by poachers and patrol teams are deployed for longer patrol shifts of not less than fifteen nights per month.

The system also advocates for an informant system whereby well-wishers of the reserve provide information to the park management regarding poaching which is treated confidential and protected through standard operation procedures. Informants are rewarded accordingly by the park management. Hunting with gin traps, firearms, dogs and wire snares are the main illegal activities encountered in Mwabvi.

Human and Wild Animal Conflict

The main human/animal conflict occurs around Shire River, where hippos, python snakes and crocodiles are the main actors. Buffaloes, monkeys, and baboons cause problems in villages around the reserve boundary.

Challenges around the Reserve

Encroachment: According to the 2008 boundary inspection conducted it was observed that a total of 227 hectares were encroached by human activity, which is a threat to wildlife and the entire wildlife reserve. Settlements by some traditional leaders, cultivation by the surrounding villages like Nthondo from with the communities from some of district, and other villagers from neighboring district Chikhwawa and part of Mozambique

Access through the Reserve: Human traffic by communities for social services in the reserve on foot, bicycle and vehicles reduce the reserves wildness and aesthetic value and which has a negative impact on tourism.

Poaching: Main animal species of the reserve such as Black rhinos have disappeared due to poaching. The communities neighboring the reserve are poor creating high demand for wildlife resources for food and cash, which has severely affected the reserve through illegal hunting using gin traps, wire snares, dogs and Firearms.

Lack of Com management: Lack and low participation in conservation by bordering communities has negatively affected the reserve because it has led to poaching, bushfires and encroachment. The reserve needs support from all stakeholders in and around Nsanje since it is a national asset. If the reserve is properly conserved it can make a good catchment area and contribute to national economy through tourism.

Other illegal activities taking place in the reserves include pit-sawing, hunting of the wild animals and harvesting of fuel wood for domestic use and burning of bricks.

f) FINDINGS

- **Demographic Characteristics**

- **Household Types and Family size**

77.4% of the surveyed households were male-headed and 22.6% were female-headed. Similarly, 37.7 % of respondents were female and 62.3% were male. In this area although women are responsible for the chores done around the homestead and many men have casual employment outside of the village, the enumerators were more likely to find and interview males.

The average household size was 5.5 (SD=2.247, n=146) with a minimum of 1 member and a maximum of 12 members. 39.7% of respondents have a family size of 1 to 4 members, which is considered as a small family (typically the husband, wife and two children). A large proportion of the households (50%) are medium sized in terms of number of members thus they have 5-8 members. Only 10.3% of the households in the sample have family members of between 9-12 (Table 3).

Table 3 Size of households

Household size	Number of households	Percent
1-4	58	39.7
5-8	73	50.0
9-12	15	10.3

- **Education levels**

In Mbenje Traditional Authority majority of the people have primary education contributing almost 54.8% of total population. 36.3% of remaining people have no any formal education and those with secondary education only contribute about 8.9 % (Figure 2).

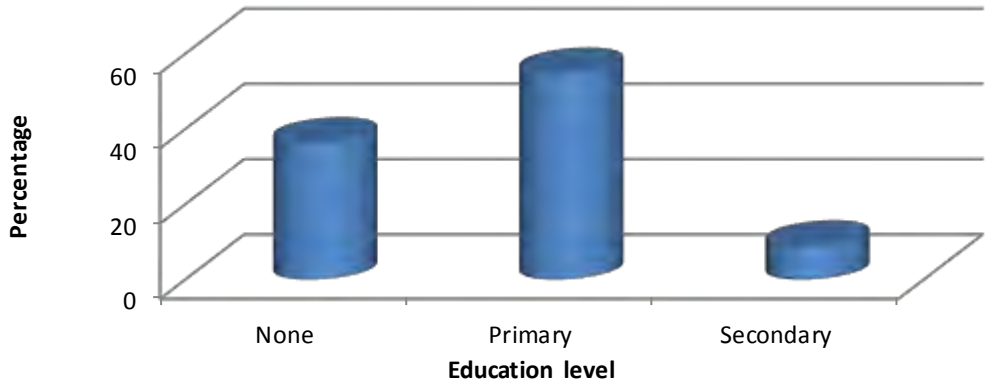

Figure 2: Education levels of respondent

- **Asset Ownership**

Efforts were made to find out the assets that households have. In this regard, respondent were asked to mention what asset they have from the list. The most common assets that people have in this area are motor, radio, chair, table, bed and cd player (figure 3). This asset proxy indicator suggests these households are very poor. No household in this area has generator, clock, or even sofa set which simply shows that these people lack basic assets and needs.

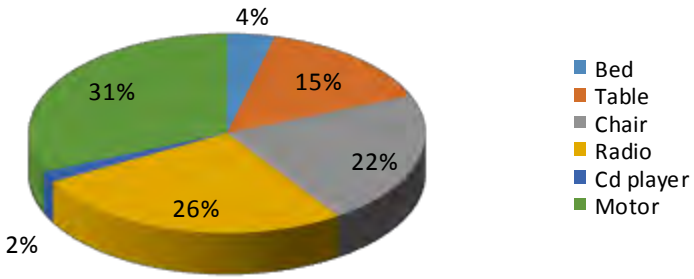

Figure 3. Asset ownership

- **Climate Change Information**

An analysis of which households are receiving any type of climate or weather related information shows that 79.5% households are receiving some type of weather or climate related information. A chi square analysis was performed to examine possible significant association between access to climate change information and sex of respondent. A significant association was observed $\chi^2(1, N=146) = 3.945, P< 0.05$ (0.047). The analysis also looked at sources of information about climate change and 64.4 % of people in this area access information concerning climate change through radios. Non-Governmental Organisations provided information to 18.6 % of households and in this area 16.9 % access information about climate change through their colleagues.

The analysis showed that men are more likely to hear information about climate change than females. It can be understood therefore that in this area more men are aware of issues regarding climate change than females. This information is very important when it comes to trainings and awareness campaign

- **Mitigation and adaptation practices**

Due to various challenges that people are facing in Nsanje related to climate change, a number of mitigation and adaptation practices have been devised such as crop diversification and planting drought tolerant crops such as sweet potatoes (Figure 4).

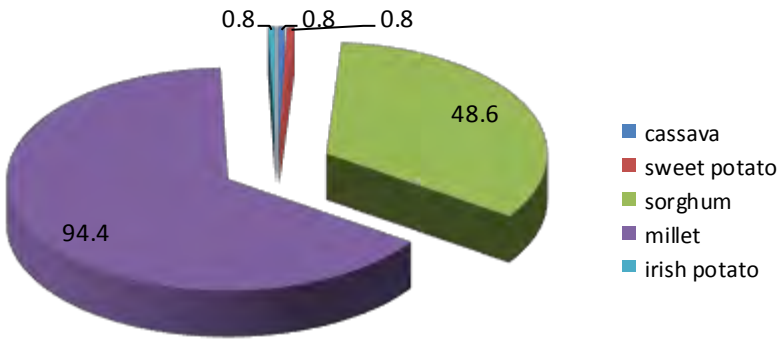

Figure 4: Drought tolerant crops

- **Naural Resource Management**

On Naural Resource Management, very little is being done to manage natural resources. The results show that 75.3% of households have made some tree/agroforestry management related efforts while 24.7 % do nothing to manage the resources. Tree planting in this area is widespread, even on the poorest farms, because there have been tree planting projects in some parts of Nsanje by local NGOs. There has also been some spill-overs to neighbouring communities, leading to adoption of tree planting practices. There is a general lack of knowledge or projects in this area dealing with other natural resources management such as soil and water conservation.

- **LAND AND WATER**

There is greater indication that agriculture sector accounts for over 80% of the economy in the district. The main programmes within agriculture sector fall into the following six broad areas: crop development, livestock development, irrigation development, extension services, land resources and conservation and fisheries.

- **Land Tenure System**

The district has three land tenure systems namely public, private and customary. Over 60% of land is under the customary land, under the control of traditional leaders and is passed on in succession from one generation to another, in order of importance of male relatives by birthright and marriage. Traditional leaders are responsible for land allocation and settling of the land disputes, but some a few disputes are referred to the District Commissioner. Most of the customary land is used for subsistence farming and grazing. The average size of land holding under customary land tenure system by sex is shown in Table 4.

Table 4: Distribution of Customary Land by Size and Sex

Land Size (Ha)	Males	Females	Total
<0.5	65.4	10.9	**38.2**
0.5 -1.0	19.2	48.4	**33.8**
1.2	11.5	29.7	**20.6**
2	3.8	10.9	**7.4**
Total	**99.9**	**99.9**	**100**

Source: Food Security' and Nutrition Survey 2008 – Ministry of Agriculture

Public land is held by the government on behalf of the population and it covers such areas and places where government buildings, roads, railway line, game reserves, forest reserves, district council facilities and national monuments are located.

Private land is Land under private ownership either on freehold or leasehold. In this case Leasehold land is land leased for a period of between 21 to 99 years. The freehold land is mostly owned by religious institutions and some land in this category is for cattle ranching.

- **General Land Use System**

Most land is mainly used for farming, settlement, grazing of animals, natural and planted forests. In Nsanje mining is done on very minute scale confined to TA Makoko where blue sulphur and Corundum are mined. Most of the land is used for subsistence agriculture with no estate farming and animals are mostly under free grazing which may results in human/livestock conflict as a result of crop destruction.

About 51% of the total land area is considered to be under arable but only 23% is under cultivation. Although most of the soils are deemed to be suitable for agriculture, inadequate rainfall (persistent drought) renders such soil unproductive under rain fed agriculture (Table 5).

Table 5: Land Use Pattern in Nsanje

Use	**Hectare (%)**
Arable (Vacant)	27.93
Arable (Cultivated)	23.04
Game Reserves/Mashes	26.93
Forest	20.92
Holding land	1.19
Total	**100**

Source: Agriculture RDP 2008.

- **Land Holdings size**

The average land holding for the district was estimated at 0.56 ha in 2008. The land holding sizes in the district vary from one TA to another. Studies have also revealed that men own two thirds of the arable land and the balance being owned by females due to the patrilineal marriage system practiced in the District, which gives men more powers to control land than their women counterparts.
An average landholding size for rain fed agriculture is bigger than that of wet land agriculture. Under rain fed agriculture land holdings range from 0.5 ha to 1.0 ha whereas wet land holdings range from 0.1 to 0.2 ha and land available for wet land agriculture varies from one season to the other depending on amount of rains received in the year.

- **Land use**

On average, a single household in this area has 1.767 ha of land for agricultural purposes. However majority of households have land holdings of less than one hectare. The results indicate that about 50 % of households have land less than 1 ha while about 41.3 % of people have land of between 2 to 3 hectares. Those with 4-5 and 6-7 hectares constitute almost 4.8 % and 2.4 % respectively (Table 6). It

can be noted from the table that there are only 0.8 % of households that have land 0f 8 hectares and above. It is apparent that in this area people have very small land for cultivation and combined with lack of farm inputs, these people are more likely to have low harvests.

Table 6. Size of cultivated land

Land size	Number of households	Percent
<1	64	50.8
2-3	52	41.3
4-5	6	4.8
6-7	3	2.4
>8	1	.8

- **Agricultural Practices**

The majority of farmers in the district follow traditional practices and common land preparation practice followed is clearing and burning of the debris prior to the onset of the rains. Very few farmers make ridges on their land except in the hilly areas.

Under dimba cultivation, the main farm activity is clearing. Some tilling and ridging is also done for sweet potato and vegetable growing. On a smaller scale, farmers use animal droppings. Usage of inorganic fertilizers is limited due to its high costs. Scarcity of land makes crop rotation and shifting cultivation impossible. The majority practice mono cropping of cereal crops.

Most farmers plant more cereal seeds per station and wider spacing of planting stations than recommended. Thinning is done after germination and this has an adverse effect on crop yields. The practice is done to safeguard against termites, drought and low seed viability despite the practice being discouraged through campaigns by Government and NGOs.

Very few practice farm mechanizations in the district. The hand hoe is the predominant farm implement alongside the panga knife. A few farmers use ploughs, ridgers hence this limited level of mechanization impedes timely operations and subsequently adversely affects farm productivity. Since in Nsanje rains are very erratic, farm mechanisation would have been crucial to help farmers maximize the short rainy seasons.

- **Crop Production**

Crop production in the district is dominated by smallholder farming which is the major occupation for the majority of the rural people in the district. The farming system is predominantly subsistence using hoes to clear land, plant and weed their crops with a few farmers using ox drawn farm implements such as ploughs and ridgers. Rain fed and wet land agriculture is the main crop production method. Wet land agriculture is dependent on residual moisture at the end of the rainy season in the dimba and the marshy lands and is done in all TAs of the District. Crops grown are maize, sweet potatoes, sugar cane and vegetables and are grown between March and May. Rain-fed agriculture is basically concentrated in the valley floor and supports the production of most of the cereal and leguminous crops as well as cotton.

The yield levels for the district do always fall below national and potential levels for most crops. Low yields in the district are attributed to land degradation, low use of improved varieties, destruction of crops by pests, limited accessibility to credit and also natural calamities such as drought and floods.

- **Irrigation Development**

The Shire River, its tributaries and some rivers and residual moisture after rains offer great potential for irrigation farming in the district. The district has a potential of 42,000 hactares of land for irrigation. The district boosts of thirty three (33) irrigation schemes. There are large areas along the Shire and Ruo Rivers and other rivers in the district that flood every year resulting in residual moisture which is used by many farm families to produce crops, resultin in a large number of farm families involved in producing crops using residual moisture. With residual moisture, labour demand is very little thus most farmers prefer it to other types of irrigation.

Since 2005, farmers received some assistance from donor funded programmes that include excavation of canals, provision of Treadle Pumps and motoried pumps.

Water for Irrigation

Water for agriculture purposes is not readily available in the area, and only 20% of the households are practicing irrigation most of which use wells (55%) as a source of water for irrigation while the remaining 45% is utilized by rivers. On average, most households have 0.37 ha of land for irrigation farming. There are a number of methods that people use for irrigation and mostly used one is watering can with 65 % households of those practicing irrigation. Apart from watering can, people also use treadle pump, motorized pump and furrow or channel irrigation methods.

Figure 5, shows that almost 10% of households use treadle pump, 20 % use motorized pump and lastly 5 % use furrow or channel systems. As for motorized pumps, it is used by people who operate in a group as a scheme due to its expensiveness but as for the rest, they are used by individual farmers.

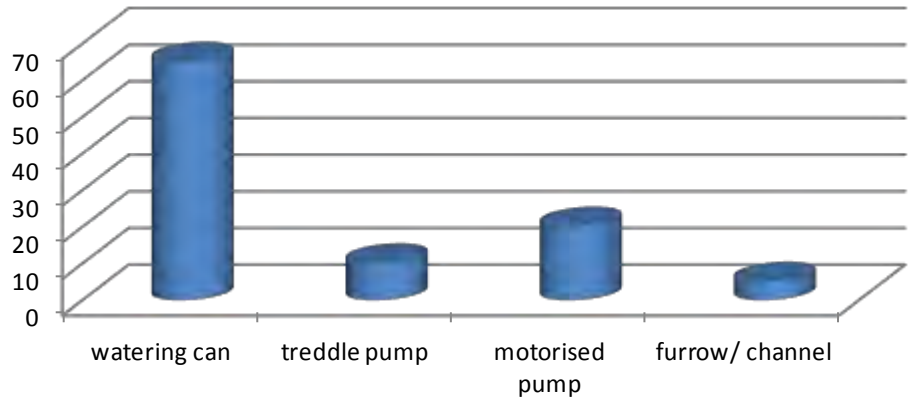

Figure 5: Irrigation methods

Constraints to Irrigation Development

Irrigation development is constrained by many factors, including: Inadequate water due to conveyance losses and environmental degradation on upper parts of most rivers such as Thangadzi and Milore; Poor water management by farmers; Inadequate inputs such as fertilizer, seed and pesticides; Inadequate funds for maintenance of existing structures; Low producer prices resulting in low returns to investment; Crop damage by livestock, especially those around the homesteads; Absence of acceptable high yielding crop varieties; Siltation of canals after floods and salinity problems; Lack of irrigation culture amongst farmers who depends on donor funding; Low utilization of low cost technologies such as gravity fed and river impoundment due to lack of perennial rivers.

- **Livestock**

Rearing of livestock is one of the occupations of the farming community in the district and the commonly reared livestock are; cattle, goats, pigs, poultry and rabbits. Most of these are indigenous e.g. Malawi Zebu, making them adaptable to the harsh weather conditions of the district and disease resistant. Although the per capita ownership of livestock is low the average number of animals per owner is high. The ratios of some livestock type to farming families are very low coupled with limited purchasing power of most people in the District. Almost 74.3 % of households indicated that they keep livestock in this area . There are a number of livestock that are reared by people including cattle, chicken, goats, ducks, doves, sheep and pigs.

In Nsanje about 86 % of those people having livestock keep chicken. Goats are kept by almost 46.7% of the population and comes second after chicken. Ducks are also common in TA Mbenje with close to 21.5 % of households keeping them. After ducks, cattle comes fourth with approximately 12.1 %. Apart from being used as a source of income cattle are also used for dowery (lobola). 10 % of people keep pigs and this is followed by dove/pigeon with 1.9 %. Keeping of sheep and Guinea fowls in this part of Nsanje is not common as each constituted around 0.9 % of the total households keeping livestock (Figure 6).

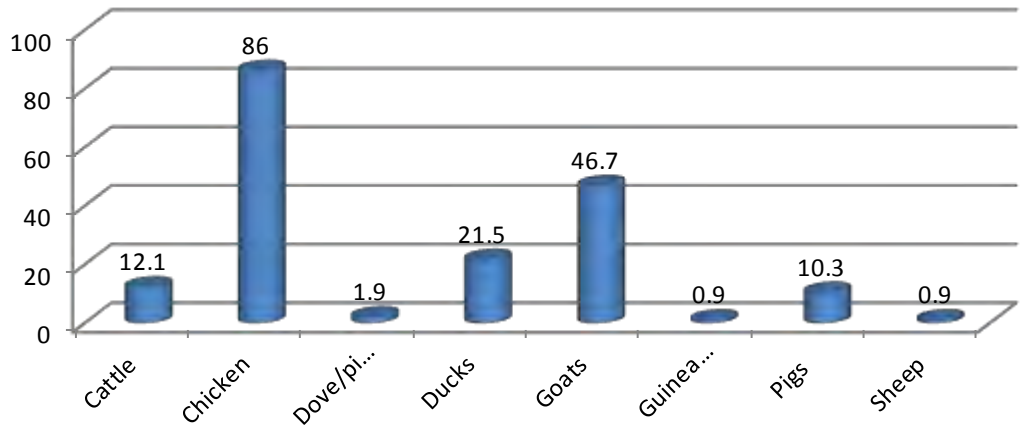

Figure 6: Livestock kept

Livestock products and their Uses

Most livestock in the district provide meat for consumption to improve the nutrition status of both locals and other urban centers such as Blantyre. Livestock is also a source of income to farmers. By-products such as hides and skins are sold to private dealers like Liwonde Tannery where they partially processed and exported for final processing and locally they are also used to make drums and mats. Livestock dung is a source of organic fertilizer, mosquito repellent and a source of energy for cooking.

- **Main sources of income and Food availability**

The households in the surveyed villages derive their income from diverse sources, and farming is the mainstay of income source for many of them. Through this study, it has been discovered that the main sources of income for people in surveyed area are farming, formal employment, remittances from relatives, and piece work locally known as “Ganyu”. Among these, farming is the major source of income with about 41.8% households relying on it. Business comes second with 30.8%, followed by piece work which contributes almost 22.6%. Remittances from relatives and formal employment contributed 2.7 and 2.1% respectively (Figure 7).

Figure 7: sources of cash income

Although a lot of people in this area depend on farming as a source of income, many households run out food before next harvesting season. There are a number reasons attached to this and such reasons including floods, drought, wild animals, lack of inputs such as fertilizer, improved varieties of crops and lastly theft. Based on the analysed results, almost 81.7 % of the people in the area are affected by floods which in turn results in low yields. From floods, drought comes second (74.3%) followed by pest and diseases (69.4%) and lack of resources comes last with 61.2% households faced with this problem.

Due to failure in farming, most of households in the surveyed area are food insecure. It can be shown that on average it takes 4 months for them to run out of food (SD=2.810,n=146). The results further indicate that only 6.2% of households do have food throughout the year while the remaining 93.8% households are food insecure. Figure 8 indicates that most households are in critical food shortages in the months August up to March the following year.

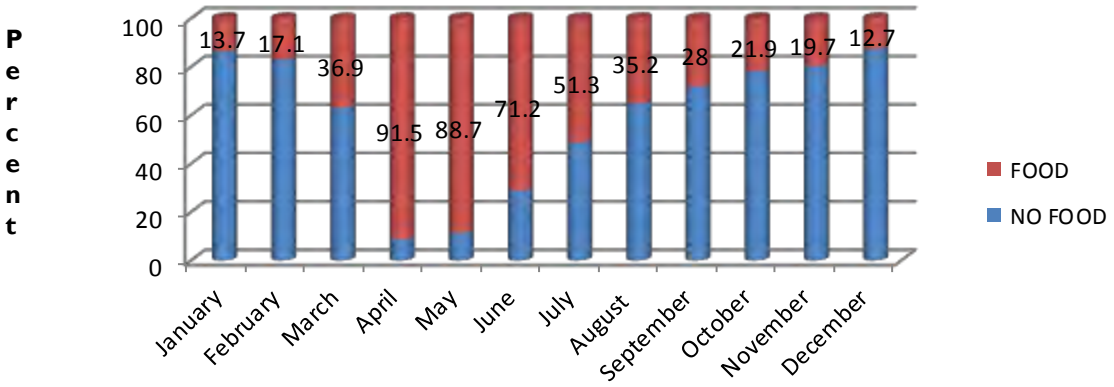

Figure 8: Food security status for people

In a year, harvesting for the long rains (the most reliable season in the area) starts April hence the availability of food from own farm. Usually long rain season is not reliable due to floods and dry spells which are order of the day and to compensate for this, most households utilize the short (winter

cropping) rain season. Harvesting for this cropping mostly starts in August, however harvests realized are not all encouraging. These survey findings are line with widely accepted empirical findings that access to adequate and sufficient food in many countries is unstable (Alinovi et.al, 2009).

- **Coping and Livelihood Strategies During Time of Floods and Drought**

  - **Livelihood and Natural coping strategies**

The study also tried to find out the natural coping strategies that people in surveyed area use in time of floods and drought. It was discovered that many households thus 50.3 % depend on firewood selling followed by fishing (29.7%), then wild fruits eating (15.9) and finally livestock selling (4.1%) (Table 7). In this area, there are a lot of forests where firewood is abundant and this is why selling of firewood is the highest. Fishing is another main strategy due to availability of Shire River which has a lot of fish species and in addition to this, it is open access meaning everybody can go and fish without any hiccup. A lot of people in Nsanje have livestock such as goats, cattle, sheep and chicken, however these are not considered as their main source of income since they are common and sometimes they are just sources of prestige and this is why livestock selling is the least method of surviving during natural catastrophe.

Table 7: Natural coping strategies

Natural coping strategies	Number of households	Percent
Eating wild fruits	23	15.9
Selling fire wood	73	50.3
Livestock sales	6	4.1
Fishing	43	29.7

On livelihood strategies it was observed that there are some strategies which are both used natural coping strategies and livelihood strategies. On daily basis, people in this area mostly depend on firewood selling (Table 8). Farming comes the third after piece work with 21 % households opting for it. From these results it is clear that people in Nsanje do not rely on farming. The reasons could be due to the challenges that they face such as dry spells, floods and lack of improved farming inputs.

Table 8: Common livelihoods strategies

Common livelihoods strategies	Number of households	Percent
Farming	31	21.7
Peice work	34	23.8
Fishing and selling fish	21	14.7
Selling fire wood	47	32.9
Selling hoe handles	1	.7
Buying and selling goats	5	3.5
Charcoal burning and selling	2	1.4
Baking and selling bans	1	.7
Remittances	1	.7

g) GOVERNANCE AND INSTITUTIONS

The formal administrative structures of Nsanje include the district assembly, local institutions established at community and district level under the decentralization process and technical institutions comprising of professional personnel from the government, statutory corporations and NGOs.

- **Government and Local institutions**

In line with the decentralization policy, Nsanje as a District Assembly is mandated by the Local Government Act (1998) to pass by-laws to govern its operations and raise funds for carrying its functions. Nsanje has 9 traditional authorities (TAs), 59 Group Village Headmen (GVH) and 465 Village Headmen (VH) who provides the main link between central government structures and rural/local communities (IRAP Survey 2008). The traditional authorities are members of the district assembly as ex-officials. Some informal structures predomination in the District are youth, men and women groups which are mostly active in income generating actives, social welfare and community development.

- **Formal Institutions**

- **District Executive Committee (DEC)**

It is a technical advisory body of the district assembly and comprises of all heads of government sectors, statutory corporations, NGOS and civil society organizations operating in the district. DEC is responsible for carrying out needs assessment, appraising, monitoring and evaluation of development programs.

- **Area Development Committee (ADC)**

The district has nine (9) ADC's which are a representative body of all the VDCs under the jurisdiction of the respective TA's. The membership comprise of the following: ADC chairpersons and their vice, ward representatives, representatives of religious faiths, representatives of youth and women groups in the area, representatives from the business community, and chairpersons of the AEC. The chairperson is elected amongst the elected members. The TA/STA supervises the committee and is an ex-officio member.

- **Area Executive Committee (AEC)**

This is a technical advisory body of the ADC and its membership is made up of extension workers from government and the Non-Governmental Organization in the area. The elected chairperson of AEC is the secretary of the ADC.

- **Village Development Committee (VDC)**

This is a representative body made up of a group of villages charged with the responsibility of identifying needs, planning and monitoring at village level and also soliciting funding of development projects. The projects compiled at VDC level are submitted to ADC. Technical support is derived from AEC. The committee is headed by an elected member or Group Village Headman. Membership of VDC includes: elected members from each village within the VDC, ward representatives, four women representatives nominated by people within a VDC, elected extension worker representatives and chairperson of the VDC is elected amongst the members of VDC.

○ PEOPLE OF NSANJE AND THEIR CULTURE

Sena and Mang`anja are the predominant tribes in Nsanje. The Mang`anja who are of Chewa origin makes up 60% of the population. 30% of the populations in the district are Sena who migrated from Mozambique. The remaining 10% is made up mixtures of such tribes as the Azimba, Amwenye, Lomwe, Yao, Ngoni and others. Nsanje people mainly speak Sena and Mang`anja and locals often mix the two when trying to communicate in Chichewa. Like the rest of the country, English is the official language while Chewa, the national language is understood and spoken by most of the people in Nsanje.

▪ Culture

People in Nsanje follow both patrilineal and matrilineal types of marriages. The Sena tribe follows the patrilineal system where the man pays the dowery (Lobola) to the parents of the wife and the wife lives at the husband's home. Lobola can be paid in form of money or livestock. The Mang`anja tribe follows the matrilineal system, where the man lives at the wife's home and a very small token is paid (normally a chicken) to parents of the wife.

In Nsanje traditionally boys and girls do under go initiation ceremonies when they reach the recommended age. Approved counselors do conduct these ceremonies and at these initiation ceremonies the initiates are advised on how to live with the elders and what roles they are going to perform as adults in the communities.

The local dances performed at different occasions in Nsanje are Utche, Valimba, Njole, Mabatcha, Mazowe, Chikuzire and Likhuba.

▪ Religion and Beliefs

Nsanje has three major religions; Christianity (70%), Islam (10%) and Mbona (20%). Worshipers of Mbona religion believe in ancestral spiritual father known as Mbona. According to this belief, Mbona resides in Khulubvi forest where two shrines have been constructed, one for Mbona himself and the other for his wife (Salima) who is usually an old woman who takes care of Mbona. The people pray to Mbona for rains during drought, outbreak of peculiar diseases and pests for animals and plague for human beings.

People of Nsanje, particularly non-Christians observe "*kupita kufa"* ritual, which is done when a family member dies. When a spouse dies the remaining spouse is supposed to perform sexual intercourse for two to three days after burial with a close relative of the deceased. In absence of the close relative, an outsider is hired to conduct the ritual at an agreed cost. It is believed that if this ritual is not done, several deaths will occur in the family.

In addition to the "*Kupita kufa"* ritual if in the family an accident has happened in form of a road accident or house burning, there is a need to perform what they call *"kupita ngozi"* or *"kupita moto"* respectively, by the concerned family member to avoid a recurrence of the same catastrophe (all these are rituals performed by sexual intercourse).These practices do accelerate the spread of sexually transmitted disease including HIV and AIDS.

Culturally when a husband dies, his brother takes full charge of the bereaved family. Grown up girls are not accommodated in their parent's houses. It is believed that when a girl aborts while sleeping in the same house with parents, the parent will fall sick and die and this is locally known as *"Tsempho".*

- **Available skills among community members**

Different skills also exist among the community members such as Weaving (mats, baskets, hats, blooms), Wood carving (hoe handles, kitchen spoons, curios), Embroidery, Pottery, Timber sawing, Brick making, Baking (pan cakes, scones). Despite the existence of the various skills in the villages the skills are not fully recognized by the various organizations operating in the district due to the following:

a) Declining levels of natural resources
b) Lack of by-laws governing equitable and lawful access to the natural resources as a result there are conflicts over use of the natural resources.
c) Low income levels amongst community members to purchase the necessary ingredients e.g. for baking
d) Lack of credit lending institutions to boost the small scale businesses
e) Limited recognition of indigenous knowledge of the by the government and other organizations

h) CONLUSIONS

- **Opportunities for Livelihood diversification**
- **Availability of land for cultivation**

The average household land holding size is 0.6 hectare in Nsanje district. This means that the main means of increasing crop yields is through agricultural intensification and crop diversification. What is needed is the intensification of agricultural technical extension and also agricultural input support in the area. The problem of low soil fertility due to sand deposits in the rift valley and soil erosion in the hills can be equally dealt with by employing the expertise of the available extension workers. Low external input and sustainable agricultural technologies should also be introduced. Bio-diversity conservation should also be factored into all agricultural practices. This means that there is need to make sure that ecosystems and livelihoods are factored into all agricultural practices.

- **Recognition by households and other stakeholders to do things differently**

Rural communities and various stakeholders in the district believe that the district could easily come out of the chronic problems by doing things differently. The chronic food insecurity requires long-term solutions that could easily be implemented by the people themselves without relying on food hand-outs. The recognition that food handouts would not sustain the development efforts of the district is the is an opportunity that needs to be capitalized and promoted in the district.

- **Dedicated Extension staff in various disciplines**

Extension workers from both the public and private sectors are available in the district though not equitably distributed.

- **Water harvesting**

Nsanje District is endowed with a number of streams and rivers which easily dry up during the dry season. However, water harvesting technologies could change the situation and make more land irrigable in the district. Government and various organizations operating in the area need to support rural communities to venture into water harvesting technologies which could also boost fish farming.

- **Availability of Village Level Institutions (VLIs).**

A number of projects have instituted village level institutions to spearhead and undertake several project activities in the district. The existence of the various village-level institutions could help improve

and promote participatory decision making processes in the district. However, these institutions require capacity building to effectively implement and perform their roles and responsibilities.

- **Indigenous knowledge and skills**

Rural communities have developed their own strategies on how to manage natural resources or survive in difficult times. However, more often than not, most of the project interventions by government and civil society organizations do not take advantage of the enormous indigenous knowledge that people have learnt from experience. Without reinventing the wheel, communities should be assisted to recognize their potential by understanding their existing knowledge and how they can utilize it to sustainably manage the natural resource base.

- **Availability of indigenous vegetables and fruits**

The Matandwe and Masenjere forest reserves have a variety of wild fruits and vegetables. The fruits such as *Tamarind* and *Adansonia digitata* could thus be processed into juices and other by-products and be sold to increase incomes for the surrounding communities and the money used to purchase household goods such as food. The vegetables such as moringa, cow peas and pumpkins would also be processed and preserved to improve the nutrition of the community members especially children.

- **A wide range of drought tolerant crops**

Apart from sorghum and millets there is a need to promote drought-tolerant crops that include cassava and yams. These crops would be used as alternative foods in the absence of traditional food crops like maize and sorghum.

- **Business opportunities**

The construction of Nsanje-Bangula-Makwasa road and the construction of the Nsanje Inland Port provide an opportunity for the people in the district to start businesses such as ecotourism. There is need to assist people in coming out with business and agricultural practices for the marshes, forest and game reserves to develop the ecotourism industry in the district. If well developed, the ecotourism industry can provide employment opportunities to many people who currently are involved in charcoal burning as an example.

- **Key Policy decisions**

- **Decentralization process**

Key to sustainable natural resource management in the district is the effective implementation of the decentralization process. Currently, community based natural resource management is faced with a number of challenges including weak village level institutions, limited financial and human resources at local assembly level, slow policy implementation processes, weak understanding of the various policies, and weak government structures at local assembly and village level. Government should commit itself to effectively implement the decentralization process by allocating the required financial, human and material resources for the process.

- **Level of understanding of policy and legal instruments**

From the study, it is clear that community members in the district rely on biodiversity for their livelihoods. All these ecosystems are of environmental benefit not only for the people of Nsanje but to the country as a whole. The impact of illegal and uncontrolled harvesting of wildlife and forest resources and products is also exacerbating the external shocks such as floods, droughts and climate

change. It is therefore imperative that local leaders and the district staff be sensitized on some key policy recommendations governing the natural resources and environmental sector. Such policy recommendations would include: equitable and secure land ownership and tenure systems among all gender groups and sustainable land management and utilization, sustainable wildlife and natural resources management, maximizing the sustainable fish and crop yields from the Shire River and other smaller rivers in the district, and the Environmental Impact Assessment (EIA) issues in any development endeavors.

- **Vulnerability of the district**

Nsanje District is prone to disasters such as floods, droughts and famine and usually the people affected are those living along the Shire River. The same people are supported by food handouts on an annual basis. This has helped to create a spirit of dependency amongst the people which is not sustainable in the long run and therefore long-term support mechanisms are required to help these people. The government needs to implement a broad policy to help people move out of the flood prone areas. Through the ministries responsible for disasters and land, the government should identify suitable land for resettling the people in flood prone areas as long-term measures supporting the people in the district more especially those prone to disasters.

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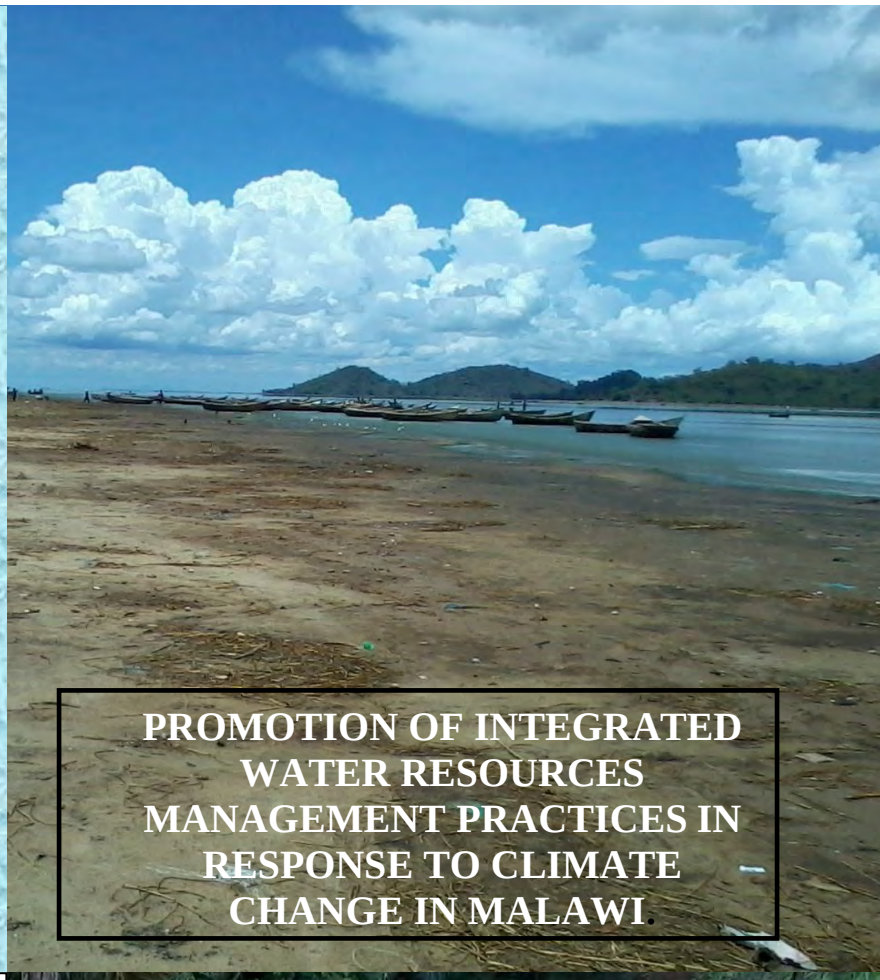
j) APPENDICES

Appendix 1: List of individuals and organizations contacted

District Assembly	NGO's	Some People
The Director of Planning & Dev.	FAST	Mr Chimombo - Education
Monitoring and Evaluation Officer	Total Land Care	Mr E. Njiku – RDP
District Community Dev. Officer	River of Life	Mr Chibisa – GOAL
District Agriculture Dev. officer	FACE	Mr B. Kumwenda- GOAL
District Forestry Officer	Action Aid	Mr Gizzex Gizai – FACE
District Env. Health Officer	GOAL Malawi	Mr Charles Ndolo- TLC
Parks and Wildlife Officer		Fred Nyirenda- Land Resource
		Ester Chilongo- Land Resource



PROMOTION OF INTEGRATED WATER RESOURCES MANAGEMENT PRACTICES IN RESPONSE TO CLIMATE CHANGE IN MALAWI.

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April, 2014

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AGRO-ECOSYSTEMS SERVICES – LINKING SCIENCE TO ACTION IN MALAWI AND THE REGION

In collaboration with

Higher Education for Development (HED), the University of Malawi (UNIMA) and Lilongwe University of Agriculture and Natural Resources (LUANAR)

April, 2014

USAID – Funded Project Report on IWRM in Malawi

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EXECUTIVE SUMMARY

Water is central to the world's economic development and lies at the nexus of achieving challenges identified in the Millennium Development Goals (MDGs), and the Malawi Growth and Development Strategy (MGDS) among others. However water demand, safe water supply; water resources management and proper sanitation are crucial concerns in Malawi and many other developing countries in Africa because of the increasing human population, urbanisation, industrial growth and climate change effects.

Integrated Water Resources Management (IWRM) has been widely accepted as the most effective approach for the management of water resources. It is defined as a process which promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of the vital ecosystems. The 2002 World Summit on Sustainable Development confirmed the importance of water and agreed to prepare Integrated Water Resources Management – Water Efficiency (IWRM/WE) Plans by 2005. The process of developing such plans was daunting and presented many challenges. In Malawi, the Country Water Partnership, with support from Canadian International Development Agency and Global Water Partnership facilitated the IWRM/WE planning process through which the major problems facing the water sector were identified. The problems include water demand management (WDM), catchment management, capacity building, and water resources management information system. Recent studies in Malawi and other developing countries have also shown that remediation of such challenges require understanding, mitigation and adaptation of climate change.

Adverse impacts of climate change on water and other sectors are evident across the world. As climate change becomes more pronounced, destruction caused by extreme weather is being manifested on water resources. Thus the need for a coordinated management of water and related resources under changing climatic conditions cannot be understated. In response to the water resources management challenges afflicting Malawi, this project sought to examine the existing capacities and challenges facing Malawi in terms of IWRM practices under changing and varying climatic conditions using the case study of Lake Chilwa basin. The project started with a needs assessment of IWRM in Malawi for the development of follow-up activities that will lead to a larger research award from an external funding agency.

Both quantitative and qualitative methods were used to collect data and the following tools were employed: questionnaires, key informant interviews, literature review and basic water quality analyses. As a baseline survey, water samples were collected in rainy season (December, 2012) from 11 selected sites in Lake Chilwa Catchment area (Likangala, Domasi, and Thondwe rivers and Lake Chilwa) in Zomba to monitor and assess the surface water quality. The samples were analysed for some major physico-chemical parameters using standard methods.
Hydrometeorological data comprising of rainfall for 8 stations, river discharge for 8 gauging stations and lake levels within the catchment were analysed for trends using linear regression and the non-parametric Mann-Kendall trend test for the period 1948-2011. Nine respondents participated and returned the questionnaire. SPSS, and Windows Microsoft – Excel (2007) statistical packages were used for content and descriptive analyses of the data obtained.

The results showed that most organisations (67%) have no existing policies, laws, practices and institutional structures to support IWRM practices. About 55.6% of the respondents highlighted the need to review laws, policies, programmes, practices and institutional structures to be in line with the

IWRM practices. The study revealed lack of political will in implementation of IWRM practices, conflicting sections in policies, weak laws, low funding and failure to establish partnerships to implement research findings. Results on physico-chemical characteristics of the surface water in the area indicated that the water is of poor quality, attributed to increased nutrient loading and anthropogenic activities. The lake registered low water levels and increased TDS (2000 mg/L) and EC levels (3998 µS/cm), and surface water temperatures (28.50-41.50 °C). The hydrometeorological analysis shows clearly consistent downward trends in basin wide rainfall, river discharge and Lake Chilwa levels. However, only the Lake Chilwa levels had trends with statistical significance, suggesting additional forcing to the climate signal.

From the findings, it is evident that the IWRM principles are fairly promoted by various sectors in Malawi due to different reasons such as lack of specialised reporters on IWRM and climate change issues leading to poor dissemination, lack of funding, lack of collaboration, poor catchment management practices and lack of partnership with institutions. This calls for a need to review existing policies and coordinated efforts in management of water resources to mitigate the effects of climate change and variability.

Signature: **Date:**

Principal Investigator
Wapulumuka O. Mulwafu, PhD. (Professor)

a) ACRONYMS AND ABBREVIATIONS

CIDA	Canadian International Development Agency
GOM	Government of Malawi
GWP	Global Water Partnership
HED	Higher Education for Education
HIV/AIDS	Human Immune Virus/Acquired Immune Deficiency Syndrome
IWRM	Integrated Water Resources Management
MEM	
MDGs	Millennium Development Goals
MGDS	Malawi Growth and Development Strategy
MSU	Michigan State University
NGOs	Non-Governmental Organizations

NWSDP	National Water Sector Development Programme
SPSS	Statistical Package for Social Sciences
USAID	United States Agency International Development
UNIMA	University of Malawi
WDM	Water Demand Management
ZDA	Zomba District Assembly

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1.0 LITERATURE REVIEW

1.1 INTRODUCTION

Water is central to the world's development activities and lies at the nexus of food security, poverty reduction, economic growth, energy production and human health among others (GWP 2011). Climate change and variability pose a very serious challenge in waters resources management and therefore requires serious consideration with a holistic view. Until lately, water has been managed by various institutions (public, private, NGOs, etc) each operating independently from one another (Mkandawire et al. 2008). This approach may be only convenient in a world where there are no constraints to the resource. However, such an approach is not appropriate in many developing countries realizing that water is a scarce resource.

Water demand is a major concern in Southern Africa because of the increasing human population and the associated demands for resources. Many people in the developing world, usually in the rural areas, do not have safe water supply and also lack adequate sanitation (Chenje and Johnson 1996). Integrated Water Resources Management (IWRM) has been widely accepted as the most effective approach for the management of water resources and it is also a critical foundation for sustainable development and achievement of the Millennium Development Goals (MDGs) among others (GWP 2010). IWRM is defined as a process which promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of the vital ecosystems (GWP 2010) and is centered on the four Dublin principles (ICWE 1992):

- Fresh water is a finite, vulnerable and essential resource which should be managed in an integrated manner.
- Water resources development and management should be based on a participatory approach, involving all relevant stakeholders.
- Women play a central role in the provision, management and safeguarding of water.
- Water has an economic value and should be recognized as an economic good, taking into account affordability and equity criteria

The basis of IWRM is that since different uses of water are co-dependent, the goal must be to manage and develop water resources in a sustainable manner. Integrated management means that all different

aspects of water resources are considered together. Water allocation and management decisions consider the effects of each use on others. IWRM, therefore, takes into account the overall social and economic goals including the achievement of sustainable development. The emphasis of IWRM is on development of water resources which is done in such a way that long term sustainable use of the resource for the future generations is assured (GWP 2011).

During the 2002 World Summit on Sustainable Development (WSSD) held in Johannesburg, South Africa, the international community took an important step towards development of more sustainable approaches in water management by including in the WSSD plan of implementation, a call for all countries to develop integrated water resources management and water efficiency plans by 2005 with support from developed countries (GWP 2011). Malawi is one of the countries that embraced the idea of developing an integrated water resources management and water efficiency (IWRM/WE) Plan. The National Water Policy of Malawi was developed in 2005, followed by the development of an IWRM/WE plan with funding from the Canadian International Development Agency (CIDA) through the Global Water Partnership (GWP). The IWRM was integrated into the Malawi Growth and Development Strategy (MGDS), the main national planning instrument. An integrated approach was also adopted in the second phase of the National Water Development Programme II and saw the revision of the water law and policy being catalysed (GWP 2010a).

Malawi, with a population of about 13.2 million, registers annual per capita water availability of 1273 m^3 (NSO 2008; GWP 2010). It is one of the most endowed countries in Southern Africa with fresh water resources availability in various forms such as rivers, streams, dams and lakes (Chenje and Johnson 1996). Nonetheless, climate change and climate variability, poor agricultural practices, rapid population growth, and poor water use and poor management of catchment areas among others, pose daunting challenges which could see access to water resources strained in the near future (GWP, 2010). Droughts and flooding are recurrent weather extremes problems facing Malawi and many countries worldwide. These problems are driven by climate change and variability and place significant pressures on vulnerable populations, such as the poor in rural and peri-urban areas who rely on untreated water extracted directly from rivers, wells and wetlands. Drought and floods also pose a major risk to essential production sectors such as agriculture that in turn affect food security (Pauw 2011). For example, in Malawi the late onset of the 2005/2006 rainfall season and inadequate rainfall during the season resulted in dwindling of water resources and subsequently agricultural production (IWRM/WE Malawi, 2008). Furthermore, studies have shown decreasing annual rainfall in Malawi from 1961 to 2006 coupled with increased inter-annual variation (Ngongondo et al. 2011; Ngongondo et al. 2014). This pattern of rainfall is also reflected in the river discharge response to the rainfall input (Ngongondo 2006; Li et al. 2012). Water quality problems related to climate change in Malawi however remain a grey area. This study therefore contributes to the limited knowledge on climatic impacts on water resources in Malawi in an IWRM context.

1.2 Challenges in Water resources Management in Malawi

Previous studies carried out in Malawi have shown that there are numerous water resources management challenges facing the country. These include inadequate water supply systems, poor sanitation, extreme climatic variations, water related diseases, poor catchment management, poor institutional structures, conflicts over water use and management, lack of management instruments and inadequate financial resources for infrastructure development (IWRM/WE Plan for Malawi 2008; Ferguson and Mulwafu 2004; and Mulwafu and Khaila 2014). Further, during the IWRM/WE planning process, these challenges were further elaborated upon in the situation analysis of the water sector and

broken down as follows: flood management, water demand management, hydropower generation, drought management, catchment management, capacity building, stakeholder coordination, water resources management information system, revision of the water act, rehabilitation and maintenance of water facilities, water quality degradation, gender mainstreaming, and HIV/AIDS mainstreaming (Mkandawire et al. 2008; GWP 2010c). Studies in some developing countries where the idea of IWRM was adopted have also shown that progress is being slowed down due to various constraints including climate change effects. In Malawi, there has been a low level of understanding of IWRM practices in response to climate change effects for sustainable land and water resources management. This study, therefore, intended to determine existing capacities and challenges facing Malawi in terms of IWRM practices under changing climatic conditions and climate variability.

In line with fundamental principles being advanced in sustainable water resources management, the study also intended to build on the three pillars of IWRM which are *management instruments*, *enabling environment* and *institutional framework* (GWP, 2011). Furthermore, this study intends to advance the four goals of Global Water Partnership (GWP) that also seek to advocate for IWRM (GWP, 2010c). Thus, in line with the above principles and goals the study intends to promote understanding, collaboration, capacity building and implementation of IWRM practices for sustainable national development under changing climatic conditions. Climate change and climate variability can be mitigated by appropriate integrated water resources management policies and adaptation measures, which reduce vulnerability for both natural and human systems (Pauw, 2011). The project also aimed at advocating for IWRM principles for mitigation of impacts of drought and flooding on water resources. Furthermore, the study sought to promote collaborative research capacities of University of Malawi (UNIMA) and the public, private, and NGO sectors as a way of achieving of IWRM principles to ensure sustainable land and water resources management – vital pillars in food security, agricultural and economic growth. The goal of the study was in line with various organisations activities including the USAID-funded Programs, USAID/Malawi's *Feed the Future Implementation Plan,* and the challenges identified in the Millennium Development Goals (MDGs), and *Malawi Growth and Development Strategy* (MGDS) among others.

1.3 Impacts of Climate Change and variability on water resources in Southern Africa and Malawi

In addition to other pressures, climate change and variability has the potential to impose additional pressures on water availability and accessibility (IPCC 2007). However, understanding the extent to which water resources will be affected is hindered in many developing regions including southern Africa is hindered by data availability at desired temporal and spatial resolutions (Bates et al. 2008). Southern Africa is however among regions to be worst hit by impacts climate change and variability due to due to low adaptation capacity (Shongwe et al. 2009). Historical assessments (Hulme et al. 2001, IPCC 2007) show that large parts of southern Africa experienced considerable increases in temperature and decreases in rainfall during the 20th century. In the future, more intense precipitation events and an increase in frequency and magnitude of droughts and floods are likely (Gleick 1987; Mason et al. 2001; Hulme et al. 2001))

The IPCC (2007) reported that projected rainfall decreases or evaporation increases will lead to decreases in runoff over most of the southern Africa region. These projected changes are however generalized for over large climatologically heterogeneous regions, with changes at lower spatial scales very uncertain (IPCC 2007). Although the changes in precipitation and evaporation translate directly to shifts in soil moisture deficits, surface water runoff and subsequently groundwater recharge, there is still a very low level understanding of the impacts of climate change on groundwater resources in southern Africa. However, the course nature of most of the regional based studies may not reveal the actual patterns of change at lower spatial resolution. Rainfall in tropical areas like Malawi has been shown to

vary at very short spatial scales (Jackson 1972, Ngongondo et al 2011). Furthermore, such assessments require a catchment based approach in accordance with the first IWRM Dublin Principal.

1.4 Potential Impacts of Climate Change on Water quality

Potential impacts of climate change on water quantity have received a lot of attention due to the apparent close alignment of water quality related issues with sustainable development (Ouyang et al. 2006; Mahjouri and Ardestani 2011). Continued pressures on water resources are bound to have an effect on water availability and productivity and this in turn will affect water quality. Natural and socio-economic systems functioning largely depend on constant supply of freshwater of adequate quality (Gleick 2006; Nangia et al. 2008). However, not much is documented on the impacts of climate change on water quality. Nevertheless, the few assessments (e.g. Butterfield and Wade 2008; Ngcobo et al. 2012; US-EPA 2013) show that climate change will affect water quality through changes in volume which will result in reduced dilution hence higher concentrations downstream of point discharges. In addition, other notable changes include enhanced growth of algal blooms in rivers and reservoirs thereby reducing dissolved oxygen, an increase in river and lake water temperatures, increased suspended solids, sediment yields, nutrient loads and associated contaminant metal fluxes. Furthermore, water quality will be affected by climate change due to increased temperature and hydrological events in rainfall that might change run-offs and mobilization of pollutants. For instance, in the case of decreased river flows and groundwater recharge, concentrations of water pollutants are expected to increase due to less dilution effects whereas frequent extreme precipitation and floods are expected to:

- Increase nutrient loads due to increased mineralization and release of phosphorus and nitrogen containing matter.
- Increase in pathogenic microbes from run-off and sewage overflows.
- Reduce oxygen content due to increased biological activities.
- Increase water colour due to increased humic substances loading.

It is therefore important to monitor and assess water quality and water quantity of selected water bodies in Malawi in response to integrated water resources management and changing climatic conditions.

Against this background, the aim of this study was to investigate on capacity needs for implementation of Integrated Water Resources Management (IWRM) principles and practices for sustainable national development under changing climatic conditions in Malawi. By using a case study of the Lake Chilwa Basin in southern Malawi, this was achieved through three main specific objectives: (i) reviewing existing policies, laws, practices, institutional structures and support in IWRM in response to mitigation and adaptation to climate change; (ii) identifying gaps and examine the role and opportunities of academia, the private sector, water service providers, managers and water users for collaboration and implementation of IWRM under changing climatic conditions; and (iii) Assessing the situation water quality and quantity the catchment for climate change and variability impacts.

1.5 Project goal

Against this background, the goal of the project was to promote understanding of capacity needs for implementation of Integrated Water Resources Management (IWRM) principles and practices for sustainable national development under changing climatic conditions.

1.6 Project objectives

The project started with a needs assessment ofIWRM in Malawi in response to changing climatic conditions. This would form a basis for development of follow-up activities that wouldlead to a larger research projectfrom an external funding agency. By using a case study of the Lake Chilwa Basin in southern Malawi, the project intended to achieve the following specific objectives:

a. To review existing policies, laws, practices, institutional structures and support in IWRM in response to mitigation and adaptation to climate change.
b. To identify gaps and examine the role and opportunities of academia, the private sector, water service providers, managers and water users for collaboration and implementation of IWRM under changing climatic conditions.
c. To monitor and assess water quality and quantity of selected water bodies in Malawi in response to IWRM and climate change.

2.0 RESEARCH METHOLOGY

2.1.0 Description of the study area

The project was conducted in Malawi, Southern Africa, using the case study of the Lake Chilwa basin (Figures 1a and 1b). Lake Chilwa, a tropical endorheic lake, is the second largest lake after Lake Malawi and covers some parts of Zomba, Machinga and Phalombe districts in Malawi and some parts of Mozambique. The lake was designated a wetland of international importance and ratified by the Ramsar Convention in 1997 (Njaya, 2001). The Lake Chilwa basin lies between latitudes 15˚00'-15˚30'S and longitudes 35˚30'- 36˚10'E. It has an open water area is around 678 km^2, which is surrounded by about 600 km^2 of Typha swamps, 390 km^2 of marshes and 580 km^2 of seasonally inundated grassland of floodplain (Lake Chilwa Wetland Project 1999).from east to west and 60 km from North to south with a total area of about 2 400 km^2. In "normal" years, open water can cover about 1 500 km^2; one-third of this is swamp and marshes, and one-third is floodplain. The entire catchment area is 8 349 km^2, of which 5 669 km^2 are in Malawi and the rest in Mozambique (Bhima, 2006).

Lake Chilwa is surrounded by about 600 km^2 of *Typha* swamps and has various useful species of vegetation, birds and fish (Morgan and Kalk, 1970; Peters, 2004). The lake is important to the economy of Malawi as it provides a large proportion (25 - 30%) of fish (Njaya, 2001; Sambo, 2007; ZDA, 2009). Lake Chilwa has several tributaries and perennial rivers that influence its hydrochemistry, water levels and the general biodiversity. These rivers include Mulungzui, Likangala, Domasi, Phalombe, Sombani and Thondwe.

The area experiences tropical climate with three main seasons namely; hot rainy (November – April), cool dry (May – July) and hot dry (August – October). The rainfall ranges between 600 in the plain areas to over 1500 mm/a in the highlands. Average monthly temperature of 11.5 °C is experienced in June and a mean maximum temperature of 29.8 °C in October (Bloomfield, 1965; ZMUP, 2007). The geology of the study area is varied and complex where most of the rocks are of Precambrian origin made up of upper Jurassic materials. The terrain of Zomba is varied and undulating due to dissections made by many streams, mountains and hills (Bloomfield, 1965; MEM, 2009).

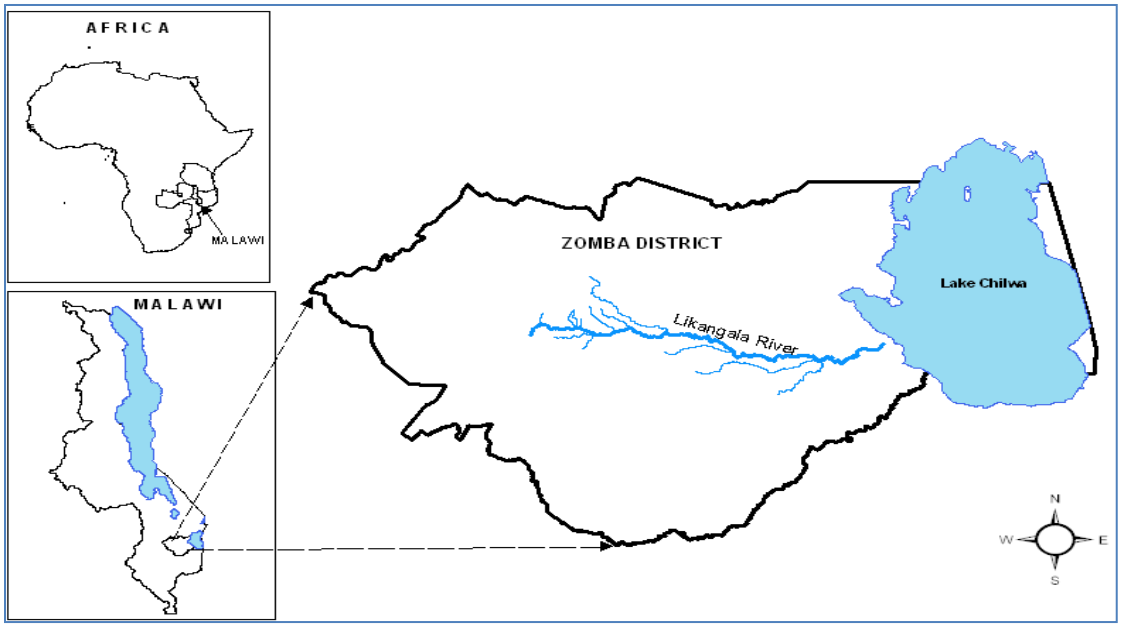

Figure 1a: Map of showing location of Lake Chilwa basin in Africa, Malawi and Zomba District

2.2 Data collection and analysis

The research used both quantitative and qualitative methods for data collection. Qualitative data were collected using the following tools: literature review, structured questionnaires and key informant interviews.

2.2.1 Data collection on IWRM practices under changing climatic conditions.

Rainfall for 8 stations within the catchment for the period 1948 to 2011 were collected from the Malawi Department of Climate Change and Meteorological Services (Figure 2). Temperature, potential and actual evapotranspiration trends at Chancellor College, Makoka and Ntaja stations were adopted from Ngongondo et al (2014) in their study on the water balance of Malawi from 1971-2001. River Discharge data for 8 gauging stations and Lake Chilwa water levels were collected from Ministry of Irrigation and Water Development, Surface Water section (Figure 3).

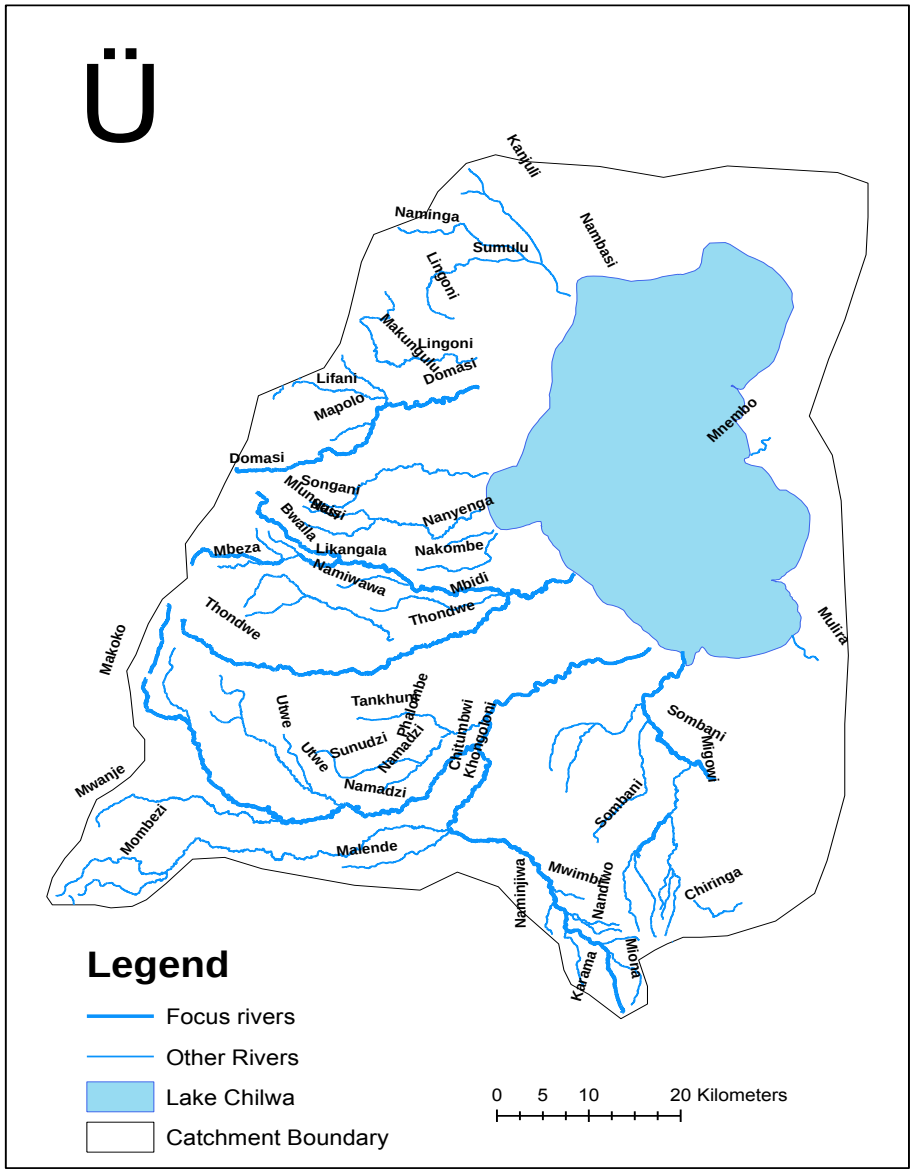

Figure 1b: Map of Lake Chilwa Basin showing the main hydrologic units

Figure 2: Map of Lake Chilwa Basin showing the rainfall stations used. Temperature and Evaporation was also analysed at Chanco, Makoka and Ntaja based on a previous study.

Figure 2: Map of Lake Chilwa Basin showing the discharge stations used

2.2.2 Data collection on IWRM practices under changing climatic conditions.

The questionnaires (Appendix 1), key informant interviews, literature review were employed to collect data on policies, laws, practices, institutional structures that support or limit IWRM practices in Malawi and the IWRM practices under changing climatic conditions. A survey questionnaire was sent to various individuals, NGO's, private sectors, civil societies, academia, Government Ministries/Departments or institutions dealing directly or indirectly with water and its related resources and products. A stakeholder consultation workshop drawing officials from government, traditional authorities and chiefs, academia and NGOs working in the Lake Chilwa basin was held in January 2014 (Appendix 2).

2.2.3 Water sample and socio-economic data collection

Several sites (11) were purposively selected in the study area (Figure 1) (Likangala, Domasi, and Thondwe rivers and Lake Chilwa). Each site was denoted as a sampling point (S) (Table 1). As a baseline survey, water samples were then collected in rainy season (December 2012) from the selected sites to

monitor and assess the surface water quality. The samples were collected in triplicate using 1Litre plastic bottles, transported and preserved in accordance with standard methods (APHA 1998; WII 2008).

Table 1: Water quality Sampling points, location and site description

Sampling point	GPS location		Elevation (m)	Site description
	E	N		
S1	0764754	8285743	682	Thondwe river near Jali market
S2	0755911	8295419	750	Likangala river confluent with Mulunguzi river near bridge
S3	0770028	8292523	650	Likangala river at Mwambo village near bridges
S4	0778816	8298787	629	Lake Chilwa near Kachulu Harbor – section A
S5	-	-	629	Lake Chilwa near Kachulu Habour – section B
S6	0756765	8308468	759	Domasi river near bridge along Zomba-Liwonde road
S7	0772229	8312574	624	Lake Chilwa near Katanda Harbor - Khuba
S8	0771060	8312993	638	Domasi river downstream near Lake Chilwa
S9	0739822	8286646	995	Thondwe river near bridge along Blantyre-Zomba Road
S10	0746911	8295426	912	Likangala river upstream near Zomba mental Hospital
S11	0749508	8295967	866	Likangala river middlestream near Zomba Sewage plant

S: sampling point. ***E***: eastings. ***N***: northings. ***GPS***: Global Positioning System

Field visits, observations, key informant interviews and literature review were employed to investigate the environmental impacts and socio-economic activities in response to climatic changes in the study area.

2.2.4 Physico-chemical analyses

The water samples were analyzed at Chemistry Department (Chancellor College) for the following physico-chemical parameters: pH, Electrical Conductivity (EC), total dissolved solids (TDS), water temperature, bicarbonate (HCO_3^-), carbonate (CO_3^{2-}), sulphate (SO_4^{2-}), phosphate (PO_4^{3-}), total water hardness, and the elements sodium (Na), potassium (K), calcium (Ca), magnesium (Mg), cadmium (Cd), copper (Cu), zinc (Zn) and manganese (Mn). Various standard methods were used to analyze the aforementioned parameters.

A field pH meter (EUTECH Instruments, Malaysia) was used to measure pH, whilst water temperature, electrical conductivity (EC) and total dissolved solids (TDS) were measured using a field meter (No. 59, MARTINI instruments, USA). Turbidity was measured using a potable turbidimeter (DRT-15CE, HF Scientific, USA). Both pH, EC, TDS and turbidity were measured on site. Total hardness (due to Ca^{2+} and Mg^{2+} ions), CO_3^{2-}, and HCO_3^- were measured in the laboratory by titrimetric method. Ion-Selective Electrode (ISE) method was used to measure Cl^- ions (APHA, 1998). SO_4^{2-} and PO_4^{3-} ions were determined by turbidimetric and method with the aid of a UV/Vis spectrophotometer (model no. 6405, England).

2.2.5 Statistical analysis

The social-economic data was evaluated by thematic and content analysis. Data obtained on water quality was entered into Microsoft Excel (Windows 2007) and SPSS worksheets to compute means, standard deviations and for content and descriptive analyses of the data. Pearson Correlation

Coefficient (two-tailed at 95%) was employed to detect relationships for the test parameters. The hydro-meteorological data were analyzed for trends using simple linear regression and the non-parametric Mann-Kendall trend test (Mann 1945; Kendall 1975) was used to quantify the significance of the trends using the freely available statistical computing software R (R Development Core Team 2008).

3.0 RESULTS AND DISCUSSION

3.1 Review of existing policies, laws, practices, institutional structures that support or limit IWRM practices in Malawi

This and the next subsections were guided by the following research questions emanating from the research objectives: *How do the existing policies, laws, practices and institutional structures support or limit implementation of IWRM in Malawi in response to mitigation and adaptation of climate change? What are the possible strategies for collaboration and participation of various stakeholders in the implementation of IWRM? What are the roles and opportunities of water service providers, managers and water users for implementation of IWRM in mitigation and adaptation of climate change?*

From the dispatched questionnaires, nine respondents participated and returned the questionnaire. The subsequent subsections, therefore, discuss the findings through the questionnaire respondents' responses and literature review.

3.1.1 Policies, laws, practices and institutional structures support or limit implementation of IWRM in Malawi

The concept of IWRM has so far been well publicised in Malawi. There have been a number of activities and initiatives that have helped to raise public awareness of the benefits of IWRM, the most significant one being the development of a national IWRM Plan in 2008. Moreover, the Malawi National Water Policy (2005) considers the IWRM as a useful strategy for effective and sustainable management of water resources. Thus although it is no longer a new concept in the country it remains an idea that is not well understood by some of the stakeholders.

Yet many of the institutions interviewed consider IWRM useful for achieving socio-economic development because it addresses issues of livelihoods. It also promotes stakeholder participation which is essential for climate change mitigation. Results from the study show that of the 9 respondents, 5 (representing 56% of institutions in the basin) observed that their institutions lack specific policies, laws and institutions to support IWRM and climate change. The instruments cited to have some relevance included the National Water Policy of 2005, Forestry Policy of 1996, Forestry Act of 1997, National Adaptation Plan of Action, National Environmental Policy of 1996, National Environmental Management Act of 1997, and the Malawi Growth and Development Strategy.

It was pointed out that several challenges confront the implementation of IWRM to mitigate the effects of climate change. In the first place, policies need to be reviewed so that they are in line with IWRM principles and also provide for better coordination. Some of the suggested policies in need of such a review are:

- Decentralisation Policy of 1997 which creates problems regarding capacity building.
- Most of the environmental and natural resources policies that were enacted before issues of climate change became prominent (after 2000).
- The Water Policy should also be revised to address issues of climate change and variability.

- Mining sector laws which are in conflict with catchment management programmes
- Policies governing pollution of water resources by industries.

The second challenge relates to lack of adequate capacity (human and financial) to implement IWRM. Most state funded institutions often do not have the requisite staff or funding to carry out IWRM activities. Third, there was lack of clear relationship between IWRM and climate change and that the media in the country does not adequately cover these issues.

Respondents were also asked to explain problems being experienced when using existing frameworks to promote IWRM practices in the context of climate change. About 77.7% argued that the current framework was either weak or inadequate and hence the need for revision. The specific problems include:

- Conflicts in existing policies and laws such as water, forestry, agriculture, irrigation
- No clear reference to issues of climate change and variability in most documents
- Lack of monitoring the impact of climate change
- Weak law enforcement and compliance
- Lack of political to facilitate IWRM and climate change implementation
- Low funding

Each of the consulted institutions came up with specific strategies that they felt could be used to promote IWRM under changing climatic conditions. But the general ones that were commonly mentioned are:

- Development of formal partnerships to undertake climate change research
- Recruitment and training of IWRM staff to work at local level
- Strengthen the networking and sharing of best practices in IWRM
- Capacity building in data collection, monitoring and research
- Increased allocation of resources
- Support the review of policies, laws, guidelines and manuals

While national institutions are undoubtedly important in the promotion of IWRM practices, local communities are equally central to the success of any interventions. The study therefore sought views on ways in which the capacity of such local stakeholders could be adapted to promote IWRM practices. The results show that local people did not know the specific technical concepts of IWRM and climate change but have some capacity which could be tapped on and enhanced. Thus areas that require more capacity building are:

- Awareness raising so that the ideas are well understood and more people could be involved in all activities
- Outreach programmes which could include short courses and projects aimed at adaptation and promotion of IWRM practices
- Collaboration with and involvement of local people through participation
- Local experiences from the basin to inform policy and legal framework. Consideration of local knowledge and coping strategies in order to improve on them

When asked to explain how climate change and variability influence the activities of institutions, respondents observed that the effects are not so direct. However, since water is the main driving force for agricultural production and fishery development, changes in rainfall patterns affect the livelihoods of people in the study area in many ways. First, climate change and variability has in some cases forced residents to change the sources of water supply from natural surface water to the increased use of

boreholes. Secondly, climate change and variability has also forced some residents to increasingly depend on forest resources.Both agricultural and fishing communities end to be very vulnerable to changes in water availability. For instance, when drought occurs, the poor people find it difficult to cope with the high cost of food arising from poor crop yields or total crop failure. The fishing communities too tend to experience a reduction in their sources of income and nutrition when fish productivity declines as a result of lake recession due to prolonged dry spells. Climate change and variability has also affected women as they have to walk long distances to collect water or get supplementary sources of energy. One issue which was raised by respondents but could not be established by empirical evidence is the fact that climate change and variability has contributed to the rise in temperatures which in turn has increased the incidents of malaria and other chronic ailments. In part, this is due to the local peoples' use of unsafe sources of water.

Mitigation measures

- Promotion of sustainable natural resources based enterprises such as bee keeping
- Tree planting in water catchment areas as well as in degraded river lines and hills
- Drilling of boreholes for potable water in order to improve
- Water harvesting and construction of multi-purpose dams for water storage

3.2 Institutional collaboration and implementation of IWRM practices under changing climatic conditions.

About 89% of the respondents considered issues of climate change and variability to be important for the country. This is due to the fact that, being a predominantly agro-based economy, Malawi depends on water resources for most of its activities and programmes. Moreover, past trends show that extreme climatic events such as floods and droughts have had serious negative consequences for the country.

On challenges experienced when collaborating with other stakeholders to implement IWRM practices, 89% noted that several setbacks existed. These include limited financial resources, poor exchange of information, failure by some stakeholders to follow guidelines and poor monitoring. In addition, it is not easy to come up with uniform approaches especially when stakeholders have different and sometimes conflicting interests.

Strategies for stakeholder collaboration to implement IWRM practices:

- Development of climate change policy
- Information sharing and awareness raising
- Creation of a multi-sectoral IWRM team to promote research
- Improved networking and capacity building for stakeholders

3.3 Monitoring and assessment of water quality and quantity of selected water bodies in Malawi in response to IWRM and climate change.

This section presents results of potential climate change impacts on water quality in the Lake Chilwa basin. The study was however restricted by the lack of historical water quality monitoring data. Water

quality monitoring data is very scanty in Malawi such that historical information on the status of water resources is very minimal.

3.3.1 Potential impacts of climate change on surface water temperature

Changes in air temperature could affect water temperature which is due to heat exchange with the atmosphere. Increasing water temperature will affect the kinetics of chemical reactions in water resulting in consequent deterioration of water quality and status of water ecology. In general the higher the air temperature, the higher the water temperature and studies have shown that such correlation is strong particularly for rivers and shallow lakes (Webb and Nobilis 2007). Projected changes in air temperature often results in water temperature changing by 50 to 70% (Solheim et al. 2010). Due to lack of regular water temperature monitoring in the Lake Chilwa Basin there are insufficient data to be able to indicate a general trend of water temperature with regard to climate change or variability. However air temperature, T, data obtained at Chancellor College (within the Lake Chilwa Basin) between 1982 and 2007 indicate an increasing trend (Figure 4) with a regression equation of the form:

$$T = 0.037Y + 21.44$$

where Y is the year number starting with 1982.

The projected increase in air temperature will increase by about 3.26 in 2070 resulting in surface water increase in the Lake Chilwa Basin by around 1.63 to 2.28 with clear seasonal dependency as has been the case.

3.3.2 Impacts on nutrients concentrations, loading and eutrophication

Increased water temperatures are expected to result in increased nutrient loads to rivers and lakes. For instance the higher the temperature the greater the release of phosphorous from sediments (Feuchtmyr et al. 2009). Higher temperatures enhance mineralization rates of soil organic matter resulting in increased nitrate leaching (Battarbee et al. 2008). There are no time series data for nutrients in surface water of the Lake Chilwa Basin except for a few scattered spatial and temporal studies. Water samples collected by the Ministry of Irrigation and Water Development for Ruo, Phalombe, Thuchira and Domasi rivers at specified locations in the Basin contained insignificant concentrations (below detection limit) of nitrate

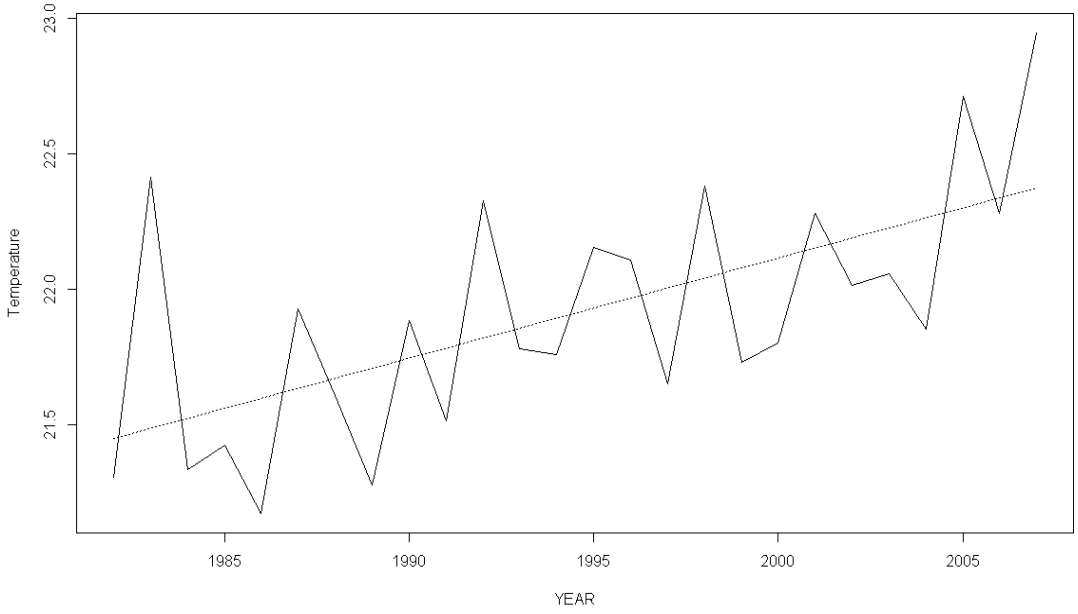

Figure 4. Trends in annual air temperature at Chancellor College in the Lake Chilwa Basin for 1982 to 2007.

Likangala River has shown to contain nitrates (3.60 – 40.00 ppm) and phosphates (0 – 10.70 ppm) with strong seasonality in the concentrations (Saka, 2006; Chimwaza, 2006; Chavula and Mulwafu, 2007; Chidya et al, 2011). Increased levels of nutrients in some parts of the Basin had been attributed to agricultural activities or from sewage treatment works. Our data collected in the rainy season (December 2012) as part of baseline data gathering for Thondwe, Likangala and Domasi Rivers are shown in Table 2. Figure 5 shows team members collecting water samples in the Basin. The data shows that Lake Chilwa is highly alkaline (pH up to 10.7 and CO_3^{2-} up to 694 mg/L) and also act as a sink of pollutants as shown by high levels of total dissolved solids (up to 2000 mg/L) and electroconductivity (up to 3998 µS/cm at the harbor)

Despite lack of data on the past trends of nutrients in the surface water of the Lake Chilwa Basin the predicted increase in water temperature will result in increasing nitrate concentrations due to increased soil mineralization. Additionally, rise in water temperature enhances rates of algal growth especially cyanobacteria. Predicted reduced river flow rates in summer will result in increased residence times of water in some reaches; consequently, increasing potential growth of algae and also enhancing settling rates of sediments. This subsequently reduces water turbidity and improves light penetration that promotes growth of algae.

Figure 5. Lake Chilwa's busiest harbor on the Malawi side (Kachulu) (Left), water sampling at the harbor by team members (Centre), water sampling in Likangala River (right)

3.3.3 Impacts on dissolved oxygen concentrations

Increase in temperature and low rainfall is expected to decrease dissolved oxygen (DO) concentrations. Increased nutrient levels and temperature may also increase respiration; consequently reducing DO concentrations (Battarbee et al, 2008). Previous studies on The Lake Chilwa Basin have indicated good levels of DO (above 5 ppm) in most water bodies for effective support of diverse aquatic population except at specific points (below 5 ppm) where there are intrusions of sewerage matter with visible algal blooming such as on Likangala River (Dias 2008; Chikopa 2010; Chidya et al. 2011).

Although time series data on DO concentrations are not available for possible prediction on future trends the higher forecasted temperatures combined with increased nutrient loading are likely to result in decreased DO in rivers and the Lake within the Basin due to decreased oxygen solubility and increased respiration.

3.3.4 Potential impacts on toxic substances

Very limited studies have been carried on climate change impacts on toxic substances in surface water (Barth et al, 2009). Depending on the nature of their hydrolysis and degradation processes most toxic substances tend to attach to other particles and settle on the bottom of water bodies. Increasing temperature will thus be of direct impact on volatile compounds such as organic pollutants and mercury. There are virtually no reported data on concentrations of toxic substances such as pesticides and heavy metals in the Lake Chilwa Basin except for very limited studies indicating concentrations of zinc (0 – 0.14 ppm), lead (0 – 0.71 ppm), chromium (0 – 0.39 ppm) and cadmium (0 – 0.05 ppm) in Likangala river by Chidya et al (2011).

3.4 Hydro-meteorological changes

This section presents results of the hydro-meteorological changes in the Lake Chilwa Catchment. Several station series were used depending on data availability. The first were those stations with monthly rainfall from which individual months could be analysed for change and variability. The second series were those with only annual rainfall data.

3.4.1 Rainfall climatology of the stations and variability

Southern Malawi was identified to have 3 rainfall regions by Ngongondo et al. (2011) in their study of extreme rainfalls. In that study, Region 1 was composed of the lower Shire area and is characterised by low annual rainfall. Region 2 was made up of parts of the middle and upper Shire extending to the southern tip of Lake Malawi. This region experiences medium rainfall. The third region is largely composed of the Shire Highlands and Lake Chilwa falls in this region. Region 3 is predominantly a high rainfall area. For the stations used in this study, Table 3a shows the monthly and annual average rainfall with the monthly percentage contributions to annual rainfall shown in Table 3b and Figures 6a to 6d shows the annual rainfall climatology at selected stations within the catchment.

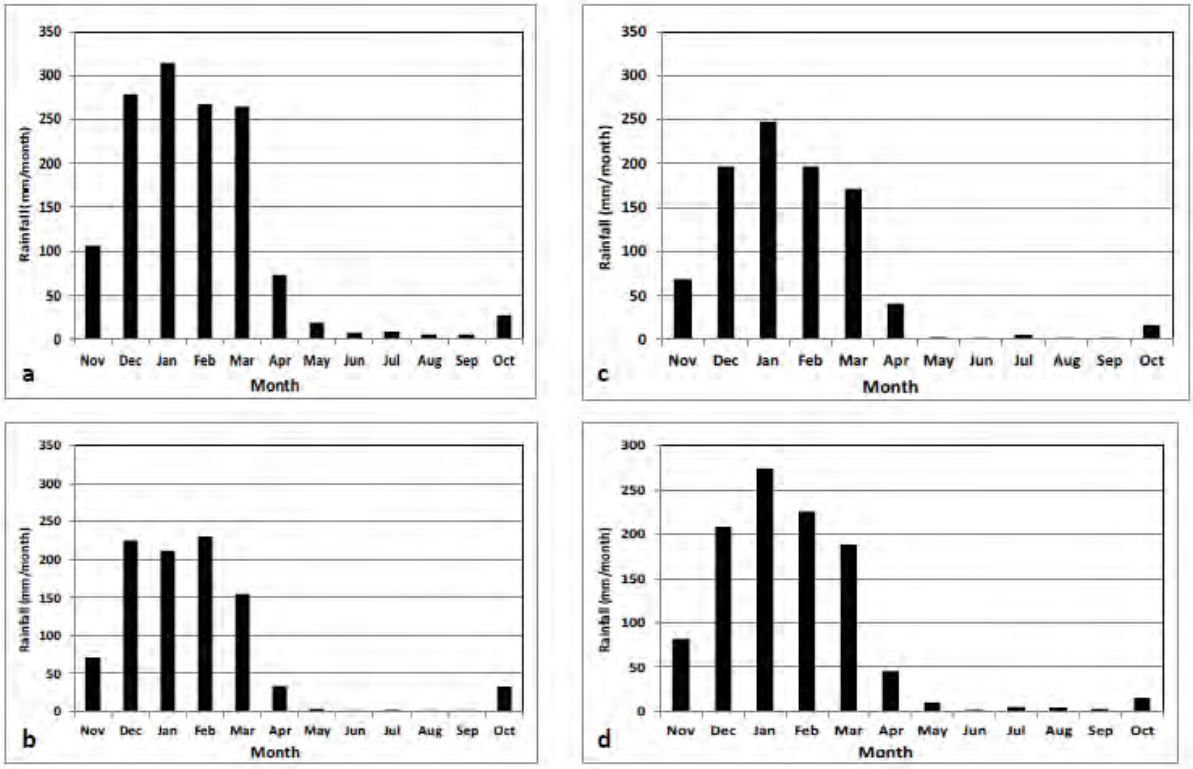

Figure 6. Annual rainfall regime at (a) Chancellor College; (b) Naminjiwa; (c) Ntaja; and (d) Chikweo stations.

Table 3a. Annual average rainfall (mm/year) and monthly average rainfall (mm/month)

Station	Annual Mean (mm)	Stdv (mm)	CV (%)	Monthly Mean (mm)
Chanco	1372.8	351.5	25.6	115.0
Ntaja	935.0	200.0	21.4	79.0
Chikweo	1047.3	269.9	25.8	89.0
Naminjiwa	875.9	234.3	26.7	81.0
Zomba RTC	1124.2	372.3	33.1	91.0
Makoka	1023.2	259.2	25.3	85.0
ZombaP	1878.7	842.0	44.8	NA
Zaone	767.7	429.0	55.9	NA

Annual rainfall mean varied spatially with the stations located at higher altitudes (Chancellor College, ZRTC, Zomba Plateau and Chikweo) having higher annual totals and monthly averages. This is clear indication of topographical influence on spatial rainfall. The monthly average annual rainfall over the catchment from these six stations is therefore estimated at 90 mm/month and the total annual average rainfall for the catchment is therefore estimated at 1128 mm with a standard deviation of 369 mm and a coefficient of variability of 32.3%. It is worth noting that most of these stations are located either on the outer slopes or plain areas of the basin with only one located on the plateaux. From table 3b, it can be observed that all stations show that over 80% of the rainfall in the catchment falls over a 4 month period between January and December.

Table 3b. Monthly contribution to total annual rainfall (%)

Month	Chanco	Chikweo	Makoka	Naminjiwa	Ntaja	ZRTC
Nov	7.8	7.7	7.8	7.3	7.2	6.5
Dec	20.2	19.6	21.1	23.3	20.7	18.3
Jan	22.9	25.8	23.7	21.9	26.0	25.1
Feb	19.4	21.2	22.0	23.8	20.7	20.2
Mar	19.2	17.7	16.1	16.1	18.0	19.6
Apr	5.3	4.3	4.9	3.5	4.3	6.3
May	1.4	0.9	0.9	0.3	0.3	0.9
Jun	0.5	0.2	0.5	0.1	0.2	0.3
Jul	0.6	0.5	0.4	0.3	0.5	0.4
Aug	0.4	0.4	0.2	0.1	0.2	0.4
Sep	0.4	0.3	0.4	0.1	0.1	0.4
Oct	1.9	1.4	2.1	3.3	1.7	1.7

3.4.2 Trends in rainfall

The results of monthly temporal rainfall variation in the Lake Chilwa catchment area are shown in Table 4a and Table 4 b shows the slopes derived from linear regression. It can be seen from Tables 4a and 4b that there is no uniform signal in the direction of the trends at the various stations. There are however strong indications that Chancellor College and Makoka Stations mostly experienced rainfall declines. The exception is January at Chancellor College which has a positive trend that was not statistically significant. Rainfall at Makoka on the other hand had statistically significant negative trends in all months except February which had a negative trend that was not statistically sign. The rest of the stations experienced rainfall increases with Chikweo and Ntaja having statistically significant positive trends in all months.

At annual and seasonal timescales (Table 4c), it can be observed that Chancellor College, Ntaja, Makoka and Zomba Plateau experienced negative trends in rainfall, none of which was statistically significant . On the other hand, Chikweo, Naminjiwa, Zomba RTC and Zaone had positive trends that were not statistically significant. The annual rainfall trends suggest that annual rainfall in the lake Chilwa Basin is therefore stationary since none of the trends are significant. At seasonal timescales, a predominance of negative trends can be observed basin wide with the exception of Chikweo which had a positive trend that was not statistically significant.

Table 4a. Mann-Kendal Trends (at ⍰=0.05 significance level)

Station	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**
	-	-	0.10	-0.18	-	-	-2.68	-	-	-	-	-
Chanco*	1.15	0.30			0.64	2.25		2.25	1.32	0.80	1.89	1.06
Chikweo	4.92	4.41	5.49	4.98	5.12	3.63	2.87	2.82	2.93	3.01	2.71	4.49
	-	-	-2.27	-0.57	-	-	-3.34	-	-	-	-	-
Makoka	3.79	2.37			2.20	2.24		2.61	2.54	2.52	2.73	1.91
Naminjiwa	1.93	1.67	2.10	1.90	1.51	1.24	0.95	0.46	0.37	0.72	0.69	1.58
Ntaja	4.27	4.16	4.91	4.32	4.40	3.45	3.95	3.89	4.29	4.19	4.09	4.19
ZRTC**	0.41	0.50	0.72	0.63	0.61	0.85	0.79	0.63	0.49	0.49	0.56	0.48

Station	**MK Trends**			**Slopes**		
	Annual	**Dry**	**Wet**	**Annual**	**Dry**	**Wet**
Chanco	-1.64	-2.69	-0.99	-6.62	-0.98	-2.89

Ntaja	-1.13	-1.13	-0.53	-2.14	-0.61	-1.49
Chikweo	0.70	0.11	0.26	7.46	-0.27	0.43
Naminjiwa	1.24	-0.49	0.87	0.53	-0.87	0.43
Zomba RTC	0.93	-1.09	1.04	34.46	-1.76	38.65
Makoka	-0.01	-2.10	0.80	1.34	-0.57	2.91
Zomba Plateau	-0.68	NA	NA	-27.18	NA	NA
Zaone	0.61	NA	NA	11.55	NA	NA

***Chancellor College, **Zomba RTC**

Table 4b. Slopes of the monthly rainfall trends (mm/year) from linear regression

Station	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
Chanco	-0.74	-0.30	0.02	-0.23	-1.86	-1.13	-0.58	-0.25	-0.01	-0.07	-0.10	0.02
Chikweo	5.78	4.41	12.31	9.89	9.12	3.29	2.12	1.76	1.80	1.79	1.76	3.39
Makoka	-3.22	-2.37	-4.31	-3.35	-3.96	-1.89	-1.71	-1.57	-1.30	-1.23	-1.29	-1.33
Naminjiwa	1.86	1.67	4.08	3.73	2.68	1.10	0.64	0.40	0.39	0.40	0.40	1.29
Ntaja	4.86	4.16	10.78	8.51	7.52	3.54	2.86	2.83	2.91	2.82	2.82	3.17
ZRTC	0.50	0.50	1.58	1.25	1.12	0.72	0.40	0.36	0.35	0.36	0.35	0.40

Table 4c. Annual and seasonal rainfall MK trends and slopes (mm/year)

Makoka and Chancellor College had negative trends that were statistically significant. In the rain season, Chancellor College and Ntaja had negative trends that were not statistically significant and the rest of the stations had positive trends that were not statistically significant. The none significance of the seasonal trends is further indication of the stationarity of the rainfall in the basin and is in agreement with the annual rainfall series.

3.4.3 Annual Temperature, Potential Evapotranspiration and Actual Evapotranspiration Trends

In their study on the water balance trends over Malawi during 1971-2001, Ngongondo et al. (2014) analysed changes in water balance components over Malawi with a special focus in rainfall, temperature, potential (PET) and actual (AET) evapotranspiration. The decreasing annual rainfall signal over Malawi in that study agrees with results from this study over Lake Chilwa and both are not statistically significant. We extract from that study trends in annual mean temperature, potential and actual evapotranspiration for stations located in the lake Chilwa Basin as shown in Table 5

Table 5 . Trends in annual temperature, Potential (AET) and Actual evapotranspiration (PET)

Station	MK Trends			Slopes		
	Temperature	PET	AET	Temperature	PET	AET
Chanco	3.16	3.02	-1.96	0.110	0.08	-0.20

Makoka	3.41	3.16	-1.00	0.021	0.11	-0.20
Ntaja	2.39	1.13	-1.50	0.035	0.70	-2.79

Slope of Temperature in ^{o}C/year, actual and potential evapotranspiration in mm/year
Source: Ngongondo et al. (2014)

From Table 5, it is noted that Temperature at the 3 stations within Lake Chilwa Basin namely Chancellor College, Makoka and Ntaja increased with statistical significance with respective slopes of 0.11^{o}C/year 0.021^{o}C/year and 0.035^{o}C/year. Potential evapotranspiration, which represents the upper limit of evapotranspiraton when there are no moisture supply and energy limitations in an area also increased with statistical significance following the Temperature trend with annual slopes of 0.08mm/year, 0.11 mm/year, 0.700 mm/year respectively. Actual Evapotranspiration (AET) on the other hand decreased at all the stations but without statistical significance at □=0.05 level. As discussed by Ngongondo et al. (2014), such a decrease in AET coupled with the decreases in rainfall is an indication of increased aridity in the catchment area.

3.4.4 Trends in Lake Levels and discharge

Monthly MK trends in Lake Chilwa levels and river discharge in the Lake Chilwa catchment area are shown in Table 6a and Table 6b show the linear regression slopes. The results show a predominance of negative trends in Lake Chilwa levels for all months although the only statistically significant trends are in October. Most of the rivers also show a predominance of negative trends. For the Namadzi River, the upper catchment (Namadzi at Namadzi Bridge) shows minimal changes without any statistically significant trends whereas the downstream reaches (Namadzi at Matiti) show considerable changes in the river flows. There is however no sonsitent pattern of the monthly mean river discharge trends with only Namadzi at Matiti having a significant trend in November, Thondwe in February and pahlombe in April and May. Sombani River on the other hand shows is dominated by positive trends expect September and November although all trends are not statistically significant. Maminjiwa, the closest rainfall station to Sombani River at Phaloni Hill gauging station also showed positive trends in all months (Table 4a). The linear regression slopes of the Lake Chilwa levels show largest declines in the months of November, December, January and February ranging between 0.059 m/year and 0.069 m/ year. However, most of the rivers had lower slopes as shown in Table 6b.

Table 6c shows the trends and slopes of mean annual lake level and discharge. The MK trends show that annual lake levels changed with statistical significance. For the rivers, all but Sombani had negative trends and Mulunguzi had a statistically significant trends. The positive trend at Sombani was not statistically significant. Evaluation of cross-correlation coefficients between annual Lake Chilwa levels and Rainfall (Table 7a) show weak correlations with only Ntaja and Zomba plateau stations having moderate correlation. The same situation was prevalent with correlations between annual Lake levels and river discharge with the only Thondwe and Sombani having moderate correlations. At annual timescale, the levels of correlations of Lake levels and the inflows from the various rivers were expected to be very strong. On the other hand, low correlation between lake levels and rainfall can be attributed to the delayed response of the lake levels to rainfall input as catchment processes are also involved in transforming rainfall into runoff which is subsequently routed to river channels down to the Lake. It can therefore be postulated that the lake response to inflows is being affected by a combination of factors including land use in the catchment area.

Table 6a. MK Monthly Trends in Lake Chilwa levels and river discharge

Station	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
Chilwa	-1.03	-0.89	-0.90	-1.58	-0.36	-0.78	0.00	-0.54	-1.87	-1.16	-1.32	**-2.14**
Domasi	0.16	-0.55	0.39	-1.36	-0.44	0.18	1.67	1.52	0.87	0.83	0.36	1.38
NamadziM*	**-3.30**	-1.85	0.36	-0.47	-1.44	-1.33	-0.40	-1.11	-1.83	-1.57	-1.60	-1.82
NamadziN**	-0.30	-0.75	0.00	-0.54	-0.15	0.05	-0.78	-0.40	0.04	0.04	-0.12	-0.90
Likangala	-1.18	-0.63	0.17	-0.35	-0.77	-0.58	0.32	0.44	-0.20	-0.57	-0.73	0.41
Thondwe	-1.33	-1.52	-0.54	**-2.28**	-0.95	-1.31	-1.06	-0.68	-1.09	-0.99	-0.88	0.16
Phalombe	0.18	-0.38	-0.60	-1.63	-1.12	**-2.15**	**-2.85**	-1.45	-1.56	-0.06	-0.40	1.90
Sombani	0.48	1.54	1.74	1.74	1.21	0.69	0.63	0.48	0.12	0.02	-0.02	-0.05

*Namadzi at Matiti and **Namadzi at Namadzi Bridge.

Table 6b. Monthly slopes of lake levels (m/year) and river discharge (m^3/year)

Station	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
Chilwa	-0.066	-0.060	-0.059	-0.069	-0.029	-0.057	-0.006	-0.036	-0.041	-0.041	-0.083	-0.100
Domasi	0.002	-0.005	-0.005	-0.039	-0.026	-0.011	0.008	0.003	0.000	0.000	0.000	0.001
NamadziM	-0.009	-0.060	-0.173	-0.165	-0.078	-0.026	0.001	-0.002	-0.001	-0.001	-0.009	-0.001
NamadziN	-0.001	-0.010	-0.004	-0.021	-0.011	0.003	-0.009	0.000	0.005	0.005	0.001	-0.002
Likangala	-0.002	-0.012	-0.008	-0.030	-0.039	-0.031	-0.002	0.000	-0.002	-0.002	-0.002	0.000
Thondwe	-0.058	-0.042	-0.052	-0.148	-0.054	-0.041	-0.024	-0.014	-0.012	-0.012	-0.011	-0.002
Phalombe	0.000	0.063	0.087	-0.002	-0.012	-0.028	-0.009	-0.003	0.000	0.000	-0.001	0.001
Sombani	0.000	-0.003	0.062	0.293	0.316	0.304	0.038	0.008	-0.001	-0.001	0.000	0.000

Table 7a. Cross Correlation of annual rainfall and Lake Chilwa levels

	Level	Chanco	Ntaja	Chikweo	Naminjiwa	Zomba RTC	Makoka	Zomba Plateau	Zaone
Level	-								

Chanco	0.44	-							
Ntaja	0.55	0.61	-						
Chikweo	0.26	0.81	0.80	-					
Naminjiwa	0.11	0.43	0.07	0.70	-				
Zomba RTC	0.12	0.84	0.77	0.61	0.78	-			
Makoka	0.18	0.30	0.01	0.25	0.45	0.42	-		
Zomba Plateau	0.52	0.73	0.86	0.92	0.12	0.68	-0.08	-	
Zaone	-0.01	0.49	-0.26	0.63	0.75	0.65	0.22	0.15	1.00

Table 7b. Cross Correlation of annual discharge and Lake Chilwa levels

	Level	**Domasi**	**Sombani**	**Phalombe**	**Likangala**	**Thondwe**	**Namadzi at Matiti**	**Namadzi at Namadzi**	**Mulunguzi**
Level	-								
Domasi	0.43	-							
Sombani	0.54	0.75	-						
Phalombe	0.35	0.70	0.34	-					
Likangala	0.15	0.75	0.82	-0.11	-				
Thondwe	0.66	0.49	0.93	0.07	0.08	-			
Namadzi at Matiti	0.42	0.50	0.78	0.01	0.26	0.45	-		
Namadzi at Namadzi	0.24	0.70	NA	0.22	0.09	0.51	0.27	-	
Mulunguzi	0.19	0.30	-0.20	0.16	0.14	-0.08	-0.10	-0.12	-

4.0 Conclusion and recommendations

The study has revealed that although IWRM principles are fairly understood by various sectors in Malawi they are not adequately promoted due to different reasons such as lack of specialized reporters on IWRM and climate change issues leading to poor dissemination, lack of funding, lack of collaboration, poor catchment management practice and lack of partnership with institutions. This calls for a need to review existing policies in water and its related resources and coordinated efforts in management of water resources to mitigate the effects of climate change and variability.

The findings of the study have also shown varying trends in some physico-chemical parameters attributed to various factors such as variation in rainfall pattern, temperatures, seasons, waste upload into water bodies and geology of the Basin. Although there is lack of water quality time series data for proper prediction of climate change impacts in the Lake Chilwa Basin, the increasing air temperature data is likely to result in increase of surface water temperature (in rivers and the Lake) by about 1.6^{0}C to 2.8 ^{0}C by 2070. This in turn may result in other problems such as: reduced dissolved oxygen, increased nutrient loading and eutrophication and increased volatile toxic compounds. The hydrometeorological analysis showed a clear and consistent downward trends in basin wide rainfall, river discharge and Lake Chilwa levels. However, only the Lake Chilwa levels had trends with statistical significance and this suggest additional forcing to the climate signal. This demonstrates a need for investigating land use cover change and other anthropogenic activities in the basin.

Water resource managers in the Basin need to address these impacts by, among other measures, reducing diffuse pollution particularly agricultural measures and river restoration activities such as tree planting on the river banks. There is also need to enhance water quality monitoring activities in order to understand current climate change impacts in the Basin. Scientific studies such as paleolimnological analyses of sediments may also help to create a long term water quality dataset in the Basin.

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Annex 1: Questionnaire that was used for stakeholder consultation

UNIVERSITY OF MALAWI

CHANCELLOR COLLEGE

PROMOTION OF INTEGRATED WATER RESOURCES MANAGEMENT (*IWRM)* PRACTICES IN MALAWI IN RESPONSE TO CHANGING CLIMATIC CONDITIONS

STUDY SITE: MALAWI
2012 – 2013

SURVEY QUESTIONNAIRE

USAID-FUNDED PROGRAMM: AGRO-ECOSYSTEMS SERVICES – LINKING SCIENCE TO ACTION IN MALAWI AND THE REGION

Greetings and welcome our valued respondent, thank you for accepting to be interviewed and share some vital information.

This survey questionnaire intends to get views and information from various individuals, NGO's, private sectors, civil societies, academia, Government Ministries/Departments or institutions dealing directly or indirectly with water and its related resources. The study is conducted by a team of researchers from University of Malawi (Chancellor College) in collaboration with USAID and Higher Education for Development (HED). The main aim of the study is to promote understanding of capacity needs for implementation of Integrated Water Resources Management (***IWRM)*** practices in Malawi in response to changing climatic conditions.

Feel free to share and contribute anything regarding the above mentioned topic. You will be asked questions guided by this questionnaire. Note that <u>your personal details and opinions will be kept confidential</u> and used for the intended purpose only.

A. Biographical details (*Personal and Institutional*)

1. **Name of interviewee**: **Institution:** Date (DD/M/Yr):

2. **Name of respondent:**
3. Organisation/Institution: Ministry of Water Development and Irrigation
   Department/Section: Water Supply Services
   Post/Position: Principal Community Water Supply Officer
   Sex: Ma☐ Femal☐ **Age:** 15-24 ☐ 25-34 35-44 ☐ 45-above ☐
   Cell/phone:

B. Background of Institution/Organisation/Department

1. When was the organisation/institution established and why?
The ministry dates as far back as the country's independence when it used to be under the Ministry of Works.

_____
___

2. What are the:

a) Main Aim /Mandate/Roles of your Institution/Department
b) Specific Objectives

a) Geographical area of operation

NB: Possible to use Institution/Organisation document

3. In general, what is the status quo of **WRM practices** carried out by your institution/organisation under changing climatic conditions
Difficult ☐ Easy ☐ Explain.
The National Water Policy does not specifically address issues of climate change with regard to WRM

C. Institutional roles/activities and IWRM practices

1. How does climate change and variability (CC & V) influence your organisation's activities

2. In an area where you are working who do you think are the most vulnerable due to changing climatic conditions with regard to WRM. Explain

3. How are the different groups of people (including the most vulnerable) adapting to CC & V in the area you are working.

4. Which programmes/activities run by your organisation respond to CC & V and WRM issues

5. To what extent does your organisation consider CC & V and WRM issues
Very important.☐ Important. ☐ Slightly important ☐ Not important ☐
Explain why/how (prompt on IWRM)
CC&V issues are important because they direct target the water resources without which provision of safe water supply may not be achievable.___

D. Collaboration and Participation

1. Which institutions/organisations/departments do you work with in implementation of your objectives, activities, etc
**Tick where applicable.* **Add and specify if not listed*

Organisation/Ministry/Department	Tick		Organisation/Ministry/Department	Tick
Ministry of Irrigation & Water			Ministry of Local Government & Rural	

Development			Devpt	
Ministry of Agriculture & Food Security			Min. of Education, Science & Technology	
Department of Forestry			Min. of lands, Physical Planning & Surveys	
Department of National Parks & Wildlife			Department of Environmental Affairs	
Department of Fisheries			Department of Meteorology	
NGO's (specify) Concern Universal, WaterAid, World Vision, Engineers Without Borders, Plan Malawi			Private Sector/Donor Community (Specify): Press Corporation, Borehole Drilling Contractors, World Bank, DfID, AusAID, AfDB, OFID, EU, JICA,Unicef,	
Academia (Universities, Colleges, Training Institutions) (Specify)			Civil Societies (specify): WESNGO Network	
Other public stakeholders (specify): Trational Authorities, Members of Parliament and National Statistical Office			Water utilities/Water Boards (specify) BWB, LWB, SRWB, CRWB and NRWB	

2. Do you face challenges when collaborating with other stakeholders in implementation of your institutional goals/objectives and WRM practices.

YES ☐ NO ☐ (Explain)

Some stakeholders implement projects without following the Ministry's policies and guidelines_____

3. What do you think are the possible strategies for collaboration and participation of various stakeholders in the implementation of IWRM practices in Malawi?

Improved networking and capacity building for most stakeholders especially NGOs_____

4. How can the approaches for sharing and understanding information on WRM practices be improved under changing climatic conditions

Increased information dissemination and capacity building as this is a new phenomenon_____

E. Policies, laws frameworks and institutional structures in CC & V and IWRM

1. Do you have policies, laws and legal frameworks used to implement CC & V and IWRM issues.

YES ☐ NO ☐ If yes state them.

_____
_____
_____
_____

_____
_____
_____
_____
_____

2. Does your institution/organisation/department have existing policies, laws, practices and institutional structures in water that **support** or **limit** implementation of IWRM in response to CC & V
   YES _____ NO _____
   If YES please specify

LIMIT	SUPPORT

3. Do you have policies, laws, programmes practices and institutional structures in water that need to be reviewed in line with the IWRM practices under changing climatic conditions.

4. What problems are currently being faced by your institution/organisation/department in using the existing legal frameworks, policies, laws etc in water?
   _____

5. Are your institutional activities/roles and programmes in line with the existing policies, laws, acts etc i.e. Water Resources Act (1969), Water Works Act (1995), Water Resources Management Policy and Strategies (WRMPS 1999 & 2005), Environmental Management Act etc
   Yes
   _____
   __

6. In general, are there strategic plans put in place by Organisation/institution to guide in the implementation and promotion of policies in WRM under changing climatic conditions.

F. Capacity building in IWRM under changing climatic conditions

7. Who are the beneficiaries of your organisation/institution/department's activities regarding IWRM?
   Beneficiaries include water utilities, district councils and communities both rural and urban.

8. In the context of IWRM, what are your organisation's impacts on:

   *Primary beneficiaries

*Service Providers

*Policy makers

9. How can your organisation capacity to adapt to and promotion of IWRM practices and issues be improved?
Support in the review of the existing policies, laws, guidelines and manuals among others and training of technical personnel in CC&V issues.

10. Are there specific needs in terms of information, training (capacity building) and products which would enhance your capacity to adapt to and promote IWRM practices.

11. How would you like to be involved in an initiative to improve capacity to adapt to and promote

12. How can the local people and other stakeholders' capacity to adapt to and promote IWRM practices be improved
Training them in these issues as well as introducing to them techniques that may help in mitigating the impact of climate change.

END OF QUESTIONNAIRE

Appendix F: Report of the Final Stakeholder Work-Shop for the Agro-Ecosystems Project: Observations and Recommendations

Report of the Final Stakeholder Work-Shop for the Agro-Ecosystems Project: Observations and Recommendations

Held at Ufulu Gardens Hotel in Lilongwe on 30th April, 2014

Compiled By:
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Introduction

This report is a synthesis of the deliberations and observations which were made during the final stakeholder workshop on the agro-ecosystems project. The workshop was held on 30th April, 2014 at Ufulu Gardens Hotel in Lilongwe. It was graced by the then Minister of Education, Science and Technology, Honourable Dr Lucius Kanyumba. The minister highlighted on the need for the university to work on tangible solutions to challenges locking out Malawi from developing sustainably.

The main objective of the workshop was to disseminate the results which the project had achieved to relevant stakeholders in working on development projects, human capacity building and policy development and analysis on higher education and agro-ecosystems. The workshop drew participants from government ministries, the non-governmental sector, academia and also the development community.

Observations made through the Implementation of the project

The deliberations of the workshop were initiated by the progress report presentation which the country project manager and the Chancellor College project leader made. Key issues which emerged from the presentation were:

1. The project through its implementation period had demonstrated that capacity building through training is possible and achievable in short to long run. The syntheses that were made from the project were that; the development partners and university should from time to time as need arise train finance and non-finance personnel on financial management for smooth implementation of research and outreach grants; the university should develop short courses on action research and research proposal development and management; the university with private sector and mainstream government should establish a competitive and well-targeted undergraduate students scholarships to aid the needy students.

   The syntheses was made upon noting that:

a. In the three years of implementation, the project had successfully supported the training of finance personnel on managing funds for USAID and development partners in general. It was revealed that through the trainings, finance personnel from Bunda and Chancellor College had tremendously improved on finance management which translated to the smooth running of the project.
b. The project supported the training of researchers from private, public and non-governmental organisations in areas of research grant proposal development and participatory action research. The researchers had alluded that the trainings were more practical and handled the "how" part of proposal development and participatory action research. The trainings were also on spot by bringing on board issues of multidisciplinary team work approach. Successful case studies were showcased in the workshop. The Chancellor College academia, particularly those from the department of physics have ably used the skills of grant proposal development and participatory action research to development a project which is working providing solar energy to milk bulking groups in southern Malawi. The project has been funded by the rural livelihoods and economic empowerment programme through a competitive grant scheme. The Bunda academia in the department of aquaculture also showcased the research grant that they got upon using the skills the two aforementioned trainings had delivered. The aforesaid grants are reported to have empowered the researchers to work in multidisciplinary teams for better impact onto the beneficiaries.
c. Two scholarships were awarded to support students for PhD studies at Bunda and Chancellor College. This was observed to be a key contribution towards enriching the university capacity to undertake research and run post graduate programmes.
d. Undergraduate students who were also supported through the project had their stories narrated. The students support was at three tier.
    - First being the scholarship support on their fees. Through this support it was reported that proper targeting had helped in the project to reach out on the very needy students. The targeting issue was attainable by working with existing college structure such as the offices of dean of students in the two respective colleges. The graduates form the scheme narrated the positive impact which the scholarship had on their student life. By staying on the scholarship the students were encouraged to work hard and earn good grades. They also acquired the attitude of excellence.
    - The undergraduate students were also supported on the internship programme. The programme exposed the students to the working environment before graduating. This was reported to have helped the students acquire the acumen that the professional world requires. Most of the internship fellows had been on a job upon graduating from the university and were reportedly performing to the expectation of their employees.
    - Students' research grants was the third tier of the programme. This was reported to have enhanced the students' skills to undertake research projects. The graduates who had worked on this tier were at the time of the meeting looking for places to undertake their MSc/MA studies or indeed administered by universities for the MSc/MA programme. One of the research grantees narrated that "the research grants have acted as a spring board to our academic pursuits".

2. Through the project, the libraries at Bunda and Chancellor College were supported with resources which enabled them to acquire electronic facilities. The resources have enriched the libraries in ensuring that they access electronic materials for the end user. This was reported as a significant

contribution given the ever growing student population which outnumbers the hardcopy resources in stock by the two respective libraries.

3. A number of studies were undertaken under the project which provided insights on how the universities should respond to the emerging challenges. The gender analysis study and the mentorship study, which are some of the studies the project initiated, have exposed the weak areas, in terms of gender and mentorship issues, which the two university colleges namely Bunda and Chancellor College have. The study reports have been presented and discussed with management teams in the respective institutions and their recommendations have been taken on board.

Major Observations and Recommendations made by the stakeholders

1. The workshop deliberations had inclined towards advocating a university degree programme on agro-ecosystem. Such a programme would address the challenges the country is facing from a holistic approach as promoted in the agro-ecosystem project.
2. Related to the introduction of the agro-ecosystem degree programme, was issue that the public universities in Malawi, have not been responsive to the emerging needs of the stakeholders which do not require a full degree or diploma training programme. Stakeholders pointed out on the need for the university faculty to remain innovative and develop short term programmes which could be offered to the general public in response to an observed gap. These programmes should come as short courses like the one the project had offered on participatory action research. It was then recommend that the short courses that the project had offered should continue to run by the respective institutions and necessary procedures should be followed to have courses adopted by respective university senates.
3. The stakeholders noted that the project has illuminated the challenges is undergoing because it has no higher education policy in place. Some of the challenges which have been exposed in the course of implementing the project and which relate to policy are:
    - Weak collaboration between the university and its stakeholders be it private and public on areas of curriculum development and review; research agenda development and research results dissemination and uptake As a result, the academia is blamed for producing products, both graduates and research outcomes that are limited for use by the stakeholders.
    - The universities and their stakeholders are at a disarray in the production of graduates and research products. This is noted through the passive role that stakeholders play in training the graduates either through providing internship places or giving guest lectures to the students or providing research grants.
    - The university curricular have no direction on how much practical vis a vis theoretical content they should contain if there are to remain relevant to providing the skilled labour force so much in need for the country's development.
    - The stakeholders made a serious observation that the absence of the policy has created the gap on formal interaction which the universities could have with stakeholders. The gap also exists on how the universities would be accountable to the public on their core business of knowledge generation.

    Noting the issues raised, the stakeholders had then requested the project managers to initiate the policy dialogue with the line ministry on higher education policy by showcasing the lessons that the project has unpacked. Parallel to this, the project managers must liaise with university senates to share the lessons drawn from the project at curricular level and also advocate for a restructuring in the way external stakeholders are involved in the curriculum reviews.

The stakeholders had also proposed the introduction of incubation programmes within the undergraduate trainings. Through this programme students would be empowered to pursue a business or research or outreach idea either in groups or as individuals and working with the stakeholders who have a strings on the theme the student or students are working on. The students would then be mentored to pursue their idea. It is envisaged that through the programme, students would acquire the skills of problem analysis and solution development. They would also end up creating jobs for themselves. While the stakeholders would have helped in training the students by transferring the skills needed in the corporate world.

4. The workshop stakeholders pointed out that the public universities in Malawi operate on a tight budget. The financial support they get is limited for them to play a meaningful role of informing the stakeholders on several development issues and also for training students at different levels. The fiscal constraints have largely hampered the industrial exposure or internship on the undergraduate programmes which the universities and their stakeholders implement or should have implemented.

   The stakeholders to this workshop requested that the universities have to deliberate put efforts which would see them liaise with: private sector, foundations and research bodies on funding opportunities. The stakeholders cautioned that such funding schemes are usually driven by the research agendas of the institutions and as such the university should be prepared to deliver results.

List of Participants

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STAKEHOLDER MEETING
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Appendix G: A Study of Work Climate of Women Faculty at the Lilongwe University of Agriculture and Natural Resources

A STUDY OF WORK CLIMATE OF WOMEN FACULTY AT THE LILONGWE UNIVERSITY OF AGRICULTURE AND NATURAL RESOURCES

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29th MAY, 2014

MICHIGAN STATE UNIVERSITY

EXECUTIVE SUMMARY

This paper reports on the findings of a mixed-methods study on the climate of women faculty in the Lilongwe University of Agriculture and Natural Resources (LUANAR) – Bunda College Campus - located in Lilongwe, Malawi. The primary aim of the study was to better understand the conditions that women and female students face, particularly, the factors that have an impact on the work lives and career advancement of women and the learning environment for female students at the University. The study was a component of a larger USAID funded project titled **Agro-Ecosystem Services: Linking Science to Action in Malawi and the Region,** the purpose of which was to strengthen teaching, research and outreach in Ag-ESS-related fields at Bunda College and Chancellor College, a constituent college of the University of Malawi, in order to contribute to poverty alleviation and agriculture-led economic growth. A survey questionnaire was administered to female faculty or academic staff members. Out of 13 members expected, the study managed to interview 11 members, representing a response rate of 84.6%. The study also collected information from key informants who included male and female staff in management positions with an aim of getting the perspective of management staff on gender issues in the University. The key informants were selected by virtue of their office. Findings reveal the low number of women faculty reflecting global trends regarding women faculty in science oriented universities. Other findings seem to flow directly from the above problem including lack of women faculty in management position. Further, the youthful nature of women faculty means that mentoring is required for them to fully develop as professional academics; however, the absence of a policy in mentoring means that women faculty do not receive enough on the job assistance to enable them to take advantage of the university's efforts to advance women faculty. Other problem that affect the day to day professional efforts of women faculty include inability to balance work/personal life, lack of family-friendly facilities to enable women faculty to fulfill their roles as mothers and faculty members. The report urges readers to interpret the findings in light of the traditional social context under which the university operates. The traditional social context is one in which men dominate. Male dominance means that some special needs relating to women faculty can be easily ignored much to the detriment of the advancement of women faculty.

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CHAPTER ONE
INTRODUCTION AND OVERVIEW

1.0 Introduction

This paper presents the findings of a gender climate study which was carried out at Lilongwe University of Agriculture and Natural Resources, Bunda College campus. The primary aim of the study was to better understand the conditions that women and female students face, particularly, the factors that have an impact on the work lives and career advancement of women and the learning environment for female students at the University.

The study was a component of a larger USAID funded project titled **Agro-Ecosystem Services: Linking Science to Action in Malawi and the Region,** the purpose of which was to strengthen teaching, research and outreach in Ag-ESS-related fields at Bunda College and Chancellor College in order to contribute to poverty alleviation and agriculture-led economic growth. The project was being implemented by the Lilongwe University of Agriculture and Natural Resources (LUANAR), University of Malawi (UNIMA), Michigan State University and Lincoln University.

1.1 Background of the Study

The project was instituted to mainly achieve six objectives one of which was to enhance gender diversity across Ag-ESS-related program activities: gender focused modules, women climate study, and undergraduate female students' scholarships. In the initial stages, partners in the project carried out a needs assessment with various stakeholders from the two universities (LUANAR and UNIMA, particularly, Bunda College and Chancellor College campuses respectively). The needs assessment was aimed at finding out what the universities can do for them (stakeholders) and what they can do for the universities to promote sustained benefits of the agro-ecosystems in Malawi. One of the major outcomes of the needs assessment was how to make universities gender inclusive. It was noted that women were invisible or not prominent among teaching staff and also in leadership positions hence the need to understand the situation further. In general, this is how the climate study for women faculty, students and staff at the LUANAR is linked to the overall project.

As noted earlier, the setting of the study was LUANAR, a newly established University. This University was established under the Act of Parliament No. 22 of the year 2011 with the mandate of providing quality tertiary education, training and research in agriculture and natural resources. Among other major reasons for the establishment of the University was to increase access to higher education in Malawi. The University started with Bunda College campus, previously one of the constituent colleges of the UNIMA. It is situated off Blantyre - Lilongwe M1 road about 35Km from Lilongwe's old town and 17Km from the M1 road. The study however, started whilst Bunda College was still a constituent college of the UNIMA.

The study was conducted using a combination of qualitative and quantitative methodologies. A survey questionnaire was administered to academic staff members and face to face interviews were conducted with students. Data was also collected from key informants who included male and female staff in management positions with the aim of getting the perspective of management on gender issues in the University. These included the Vice Chancellor, the Senior Assistant Registrar, former Principal (of the then Bunda College of Agriculture, a constituent college of UNIMA), Deputy Deans and Heads of Departments.

1.2 Report Layout

The remainder of this report presentation is made up of Chapters Two, Three, Four, Five and Six. **Chapter Two** presents a review of the literature on the working climate experienced by women faculty in different parts of the world. This puts into context the work climate of women faculty at the Lilongwe University of Agriculture and Natural Resources. **Chapter Three** presents a discussion and the step by step processes taken by the researchers in implementing the study. The findings of this study are presented in **Chapter Four**. In presenting this chapter, an attempt has been made to be faithful to what respondents and key informants told the researchers. Thus, most claims have been supported by verbatim quotations drawn from the replies respondents and key informants. **Chapter Five** provides an analysis examination of the findings and attempts to place into the necessary context for a more assessment of the context from they arise. The final chapter, **Chapter Six**, concludes the report.

CHAPTER TWO
LITERATURE REVIEW

2.0 Introduction

The literature review presented below reveals a number of key issues regarding the gender climate for women faculty. The literature review reveals that there is a low number of women faculty especially in the sciences in universities across the world including the developed world. Furthermore, the literature review exposes the multiple roles women faculty play at home and at work which make it very difficult to perform as well as their male colleagues at work. Apart from that, the lack of child care facilities at home makes it difficult for women faculty to balance their roles as mothers.

The researchers attempted to place the study within the particular context of women in academia by conducting a review of relevant literature. In Malawi, literature on gender dimensions of women faculty in the University is scanty. In 2009, Bunda College carried out a gender analysis study which zeroed in on gender-based violence encountered in the colleges processes and activities and how such violence affects men and women. The study which used mixed methods approach concluded that women at the college, especially female students experience a noticeable level of emotional abuse through verbal insults from the male faculty.

2.1 Low Numbers of Women Faculty

Regarding female academics, Mama (2003) underscored the low number of women in Faculty and Management positions in institutions of high learning. The author called upon fellow researchers to isolate the significant underlying factors from a pool of variables potentially responsible for the scenario observed. Such variables include; few women accessing tertiary education, the effect of multiple roles of women which hamper their competitiveness, affirmative action in universities to increase female students' enrollment, problems in balancing home/work life. Bennett, Salo, & Dosekun (2007), in a study on women empowerment, again noted the low numbers of women in university faculty positions and decision-making positions compared to men. Similar finding have been reported in Australian where, in 2005, women were more likely than men to be in positions at junior and middle ranks, and the proportion of women declines inversely with the increase in the seniority of positions (Australian Educational Policy Institute, 2007).

The literature also notes the low number of female faculty members in the science. In this respect, Ceci and Williams (2010) reviewed data collected in the preceding 20 years on gender disparities in science.

The longitudinal data disputed some of the claims of women being discriminated in science related disciplines because of gender issues. The researchers proposed that in the contemporary society, focus should be recast on availing resources to support and empowering women interested in science-related disciplines rather than allocating resources towards research focusing on gender inequalities. The proposal was based on the notion that career choices and ability influence recruitment in science based positions. The authors strongly argued that there was no discrimination in publishing scholarly articles; women have equal opportunities as men to publish scholarly articles so long has the paper meets the defined criteria for publishing. The same argument was put forward in accessing grants. However, the researchers pointed out that at times women are not fully supported by fellow women.

In contrast to the gender climate in science, Hjerm & Dannel (2013) reported that female researchers are discriminated against in Swedish universities. The authors reported that despite efforts to increase the number of female researchers and ameliorate the research environment for an equal playground between males and females, few female researchers exist. In analysing the changes in chances accorded to males and females the researchers concluded that:

> *'women are significantly less likely than men to become professors and that this situation is not improving over time in spite of policies that have tried to increase the proportion of female researchers'*

In conclusion, Hjerm & Dannel (2013) called upon Universities faculties and departments to change how they organize networks and resources to further ameliorate the climate of women in the university taking into account the multiple roles undertaken.

Despite the increase in women's access to higher education, the promise of equity has, by and large, not been realized especially in view of what women have achieved in higher education and participation in the economy. Regarding curriculum integration, women studies programs and feminist scholarships which have contributed to the tertiary sector are considered to be women generated alternatives to male dominated higher education (Kelly, 1991).

2.2 Multiple Roles

The authors argued that women's multiple roles compound their ability to efficiently manage work challenges. Consequently, such a negating climate impacts work-place related achievement. In conclusion, the researchers attributed the failure to rise professionally to the multiple roles such as motherly roles and the lack of social amenities within the working environment such as lack of child care facilities at work places.

Similar to this study, a 2011 Sri Lankan Social Justice Research Centre conducted a mixed approach study aiming to provide insights into women empowerment at the work place. The authors (Hancock, Middleton, Moore, & Edirisinghe, 2011) faulted the traditional policy response to gender equality and inequality of gender mainstreaming. Gender mainstreaming was noted to be problematic as it arguably merely institutionalizes gender into all programs. Furthermore, such a response was noted to envisage women as powerless victims and consequently a necessary target for aid, rather than active agents in institutions. This was noted to be consistent with structural and systemic processes in patriarchy societies. In conclusion, the authors echoed the need for more intensive research that aims to unearth varied women voices as proposals to transform their subordinate positions in the work place.

Work-family conflict is a form of inter role conflict in which role pressures from work and family domains become an obstacle to employees' job performance. Those women who choose to combine full-time academic work with motherhood face tremendous challenges in terms of hours, stress and work/family conflict (Baker, 2008). The demands of domestic duties combined with the demands of a challenging and time-consuming career creates tension and introduces stress into one's life (Gunter and Stambach, 2003). Work-family conflict arises when pressures from work becomes incompatible with those from family domains. Conflict arises when employees extend their efforts in satisfying their work demands at the expense of their family demands or vice-versa (Ogbogu, 2013).

Outcomes of research have constantly demonstrated that work-family conflict is prevalent and a common experience of women in the workforce. This is a major source of stress which negatively impact on employees' job performance, well-being and relationships. Female employees are more likely than men to experience the work-family conflict. There are three types of work-family conflicts. These are: time-based conflict, strain-based conflict and behaviour-based conflict. According to them, time-based conflict occurs when time spent on activities within one role cannot be devoted to activities within another role. This implies that time obligations from role make it physically impossible to fulfill expectations from another role. Strain-based conflict is when roles are incompatible such that the strain created by one makes it difficult to comply with the demands of another. Strain-based conflict occurs when the strain from a given role affects one's performance in another role. In this way strain from one role which can include stress, tension, anxiety and fatigue makes it more challenging to fulfil obligations from another competing role. The final type is behaviour-based conflict in which specific patterns of in-role behaviour may be incompatible with expectations regarding behaviour in another role (Ogbogu, 2013).

Academic progress in women staff is hindered by heavy teaching loads, administrative job assignments, project supervision, teaching large undergraduate classes, assuming greater student advisory and counseling functions etc. As such it is difficult for academic women to coordinate work at the university with family responsibilities.

The work-family conflict is triggered by the family based factors. These include: marital conflict, number of hours spent by females on household duties, childcare and extended family care and support. The most related variable to work-family conflict is the number of children female academics have because a lot of time is spent in this aspect and universities have paid little attention to understanding work-family conflict experiences of academic women (Ogbogu, 2013).

A study by Ogbogu (2013) noted that 50% of respondents had no higher qualification than the master's degree because the burden of caring for their children prevented them from proceeding for the doctorate degree. Previous studies have shown that having young children is related to role strain and time shortage for completion of postgraduate programmes as evidenced by the 72% of respondents who had 1 – 3 children, while 28% had up to 4 and even more. This result confirms the fact that majority of the respondents are women with young children who are still at their child-bearing stage, and shows that work and family roles induce stress spill over from one domain to the other. One of the greatest challenges in balancing career and family occurs when children arrive. For women, the crucial years for launching and advancing in career often coincide with peak childbearing years (the mid 20s to late 30s). Just when women need to be at the most productive stages in their careers, they often find themselves taking maternity leave and have large demands on time outside work for family reasons. To some extent, men face a similar problems with this issue too, although often less severely because of the

greater responsibilities usually taken up by women when it comes to family, and especially infant-care issues. (Sandow et al, 2002)

2.3 Workload that Hinder Progress

Interestingly though, Ogbogu, (2013) reveals that theses supervision (36.8%), attending meetings and engaging in administrative assignments (33.2%) and lack of policies that respond flexibly to women as care givers (32%) did not trigger work-family conflict. This may be due to the fact that theses supervision is a meaningful and interesting job schedule which results in publication outcomes, a major prerequisite for elevation in academia. Women with older children may be able to spend long hours at meetings because they are less saddled with child-rearing practices. Furthermore, lack of family friendly policies does not seem to be a source of conflict probably due to the ideology of patriarchy in the Nigerian society that believes that women alone must engage in the multiple roles of caring for the family. Apparently, women internalized these roles and did not complain about them. The preceding is particularly true in developing countries where, according to Sandow et al (2002), there are social and cultural expectations of women to play dominant roles and bear much responsibility in extended families. Thus, it is not easy for a woman to hold a serious scientific research position with large commitments expected for family needs.

A study at the University of California found that women faculty or academic staff who were between the ages of 30-50 with children reported working 100 hours per week when they included academic work, childcare and housework. In contrast, their male counterparts reported working 85 hours per week (Baker, 2008)

Research has shown that publication productivity plays an important role in the promotion or rank of university lecturers or professors but that the publications produced by women tend to be awarded less value for promotion. Academic women have a higher probability of divorce than men. One might assume that married women scientists particularly those who have children publish less than their single peers who do not have children. It appears that women scientists with children prioritize both work and family responsibilities at the expense of other activities and interests (Baker, 2008). Women with children and those without children admitted to difficulties in fulfilling both work and home obligations (Gunter and Stambach, 2003). In general, women feel more tired than men. Thus, women with children will be more vulnerable to fatigue than their female colleagues who do not have children or, indeed, their male colleagues. This explains why nearly 40% of all full-time employed women in the study, who relatively recently have become mothers, want to work fewer hours (Nordenmark, 2004).

2.4 Lack of Childcare and its Effect on Productivity

Child care is an issue that is handled very differently from country to country, but a common theme in developing and developed nations is that women tend to be responsible for the bulk of child, family, and elderly-parent care. The availability of high-quality child care for children of all ages, for the whole workday, and near the workplace was viewed as a high priority. This is exacerbated by the discomfort some women may feel about paying someone else to do the job of child-care since child-care is something which is traditionally a mother's role. In most countries, children's caregivers are paid low wages to do a job the mother would be doing if she were working at home rather than at work. Thus, some women tended to have guilty feelings about hiring someone to do child-care work for them. Having child care at or near the work site would go some way toward alleviating this situation, because the parents could easily drop in on the child during lunch breaks or when they are concerned. (Sandow

et al, 2002). This agrees with what Cohen's (1993) recommends that child care facilities should be made available and affordable.

2.5 Conclusion.

The foregoing literature review reveals issues that govern the climate under which women work in university across the world. Thus, the literature paints a negative picture of the conditions under which women faculty work. Issues such as the multiple roles women faculty play at home and work reveals the tensions that women faculty face on an everyday basis. Given the global nature of the above literature, it is fair to expect that similar findings will be revealed in this report.

CHAPTER THREE
METHODOLOGY

3.0 Introduction

This chapter introduces the methods used to collect and analyse data. It begins by discussing the sample and sampling protocols followed. Then it describes the data collection process and the analysis.

3.1 Sample Description

The study was conducted using a combination of both qualitative and quantitative methodologies. A survey questionnaire was administered to female faculty or academic staff members. Out of 13 members expected, the study managed to interview 11 members, representing a response rate of 84.6%. In terms of distribution, most of the respondents were from the Home Economics and Human Nutrition, and the Forestry and Horticulture Departments.

It was revealed that the field of home economic and human nutrition has historically been considered for women where women are trained to perform their roles as women and mothers better through enhanced training in cooking. Furthermore, until in the mid-1990s, all faulty in the Department were females and the proportion of male students were also considerably very low. However, the trend has gradually been changing with more males joining the profession nowadays with the introduction of other programmes such as family science, food biotechnology offered in the Department.

The study managed to collect data from faculty members of all the three academic faculties in the University. It was, however, noted that some Departments did not have representation in the study because the respondents did not respond to appointments for interviews despite several attempts from the research team; non-response to emailed questionnaires and lack of female faculty in the departments at the time of the study. The Agricultural Engineering, Agriculture and Applied Economics Departments had no female faculty members at the time of the study.

Table 1: Distribution of women faculty by departments.

Department	Frequency	Percentage	Faculty
Crop and Soil Sciences	1	9.1	Agriculture
Home Economics & Human Nutrition	3	27.3	Agriculture
Extension & Rural Sociology	1	9.1	Development Studies
Agribusiness Management	1	9.1	Development Studies
Agriculture Education & Development Communication	1	9.1	Development Studies

Environmental Sciences	1	9.1	Natural Resources Management
Forestry & Horticulture	3	27.3	Natural Resources Management
Total	11	100.0	

3.4 Key Informants

The study also collected information from key informants who included male and female staff in management positions with an aim of getting the perspective of management staff on gender issues in the University. These include the Vice Chancellor, Senior Assistant Registrar, former Principal and current Vice Deans and Heads of Departments regardless of sex. The key informants were selected by virtue of their office. Out of the 8 key informants expected, five were interviewed, representing a response rate of 62.5%. The main challenge for the remaining three was failure to secure appointments for the interviews.

CHAPTER 4
FINDINGS

4.0 Introduction

The findings chapter explores the total climate under which women faculty work. The findings demonstrate the balancing act which women must perform in order to fulfill their responsibility at home and at work. Considering their traditional roles as nurturers, there is tension resulting from these differing roles. At work women faculty have to advance up the professional ladder without the aid of mentoring. However, certain policies related to employing women faculty appear to help in increasing the number of women faculty at LUANAR.

4.1. Profile of Women Faculty at LUANAR

4.1.1 Distribution of Respondents by Academic Departments and Faculties

The study was conducted using a combination of both qualitative and quantitative methodologies. A survey questionnaire was administered to academic staff members (women faculty). Out of 13 members expected, the study managed to interview 11 members, representing a response rate of 84.6%. In terms of distribution, most of the respondents were from the Home Economics and Human Nutrition, and the Forestry and Horticulture Departments.

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4.1.2 Distribution by Age, Length of Service and Leadership Positions in the University

The study also collected data on the age groups of respondents in order to ascertain composition of faculty members. It was discovered that the University generally comprise of youthful women faculty (72.8% were aged below 40). All the women faculty interviewed were on full time employment with the University. Table 2 shows the distribution of women faculty interviewed by age.

Table 2: Age distribution of Women Faculty

Age (Years)	Frequency	Percent
26-30	3	27.3
31-40	5	45.5
41-45	1	9.1
45-50	1	9.1
51-60	1	9.1
Total	11	100.0

In terms of length of service, the study found that the average number of years of service was 9.8. It was, however, noted that there was a very wide variation on the length of service among the faculty members, with the shortest service of 3 years and the longest service 20 years.

Since most of the women faculty are youthful, they have high expectations from the job. This view is reflected in the next section on factors that have influenced work/personal balance where the women faculty have to meet the demands of caring for children, and for adult dependents associated with the active ages groups.

The respondents were also asked whether they were holding any university leadership positions at the time of the study or before. It was found that about half (5) of the respondents had been in university leadership positions at one time since joining the university.. Only one respondent did not indicate whether she had been in leadership position or not for personal reasons.

4.2 Personal/Work Balance for Women Faculty

The study explored how women faculty balance domestic/personal demands with work pressures. This was perceived an as important issue in the study because in the Malawian societal context, women are expected to prioritize management of domestic chores and family such as caring for children and other dependants in addition to formal employment. A study by (Tsikata, 2007) in the University of Ghana revealed the disadvantaged position which women faculty have in regard to career advancement. This is due to the limited time that they allocate to writing and publishing because of the need to balance these

tasks with performance of domestic chores. In such settings, men have more time in performing tasks that result in their being recognized faster than women faculty.

4.2.1. Number of Dependants in the Women Faculty Homes

The study also explored the number people living in the households of the women faculty who were interviewed and how many people earn income. The findings reveal that the average number of members contributing to participants' household income was two. It was also noted that most households have the burden of caring for not only their biological children but also other dependent children. The study also found that on average, women faculty take care of two biological children (under the age of 12) and three dependent children. Furthermore, the average income earners that was available for domestic use was two, which in most cases were the spouses of the women faculty.
The study found that the number of people that were dependent on the women faculty and their spouses has serious implications on the need to balance professional work with domestic/personal life. When asked whether women faculty feel that they have problems balancing their professional work with domestic/personal life, the majority (54.5%) of the respondents admitted that they usually face challenges, 18.2% reported that they face challenges sometimes and 27.3% do not face any challenges.

Table 3: Dependency Burden of Women Faculty

Responsibility	Minimum	Maximum	Average
Number contributing to household income	1	2	2
Number of dependent children	1	8	2.6
Biological children under 12	1	5	1.6

4.2.2. Factors that Influence the Work/Personal Life Balance of Women Faculty

Many factors were reported to contribute to the problem of women faculty's ability to balance work and domestic pressures. The main challenges reported were as follows:

i. The university does not have properly defined schedules for various activities such as meetings. It was reported that some meetings start late in the afternoon and do not finish until evening. One woman faculty interviewed stated:
"There are times where I have failed to attend to my child's home work because of arriving home very late in addition to bringing some work to be completed in the evening at home."
Such complexities make it difficult for female faculty to contribute fully to home tasks in an attempt to meet the demands of the office.

ii. In some cases, lectures scheduled very early in the day or very late in the day take women faculty away from home for too long. In addition, they have long distances to travel to and from the work place; they do not have adequate time to attend to the needs of their households such as helping children to do school homework. .

iii. In other cases, women faculty have extra-ordinarily big classes to teach. This is further reflected when grading assignments and examinations as there is limited allocated for these tasks regardless of class size. It was reported that in most cases, lecturers are given only two weeks to mark examinations, which is difficult for large classes.

iv. The challenge of caring for infant children is also big especially for nursing mothers. Some women end up leaving work places very early if they do not have nannies that can take care of the child whilst at work. The problem is exacerbated by the fact that there are no reliable childcare homes/facilities around the University.

4.2.3. Recommendations to Improve Work/Personal Life Imbalance

Respondents were asked to make recommendations to improve the situation in relation to 4.2.1 above. The following are the suggestions:

i. The University should have a reliable fixed calendar of events prepared in advance. The calendar/working model should, however, be flexible enough to ensure that women needs and demands are accommodated.
ii. There should be an improvement on how the administration handles administrative issues to improve efficiency of operations.
iii. The University at all levels should be welcoming to opposing views without unnecessarily personalizing issues. In most cases, women do not voice out their concerns for fear of reprisal if they are seen as presenting a view contrary to the dominant view.
iv. The University should provide for childcare facilities within the campus in order to accommodate women operating from town with infant children.

4.2.4. Level of Impact of Various Factors on Work/Personal Life Balance

The study also explored how the various work/domestic factors affected the women faculty's ability to balance the domestic and professional work pressures. The impact was in this study classified as either positively or negatively affecting the women faculty.

The study found that there was diversity in the factors that affected the women faculty's balance of work and personal life. Out of 11 respondents, the following were the most important factors as they were the most frequently mentioned factors (5 times):

a) Availability of funding. All respondents indicated that availability of funding negatively affected their work/personal balance. It was also reported that the university has no funding for faculty to engage in research areas of their choice. In most cases, staff respond to calls for proposals from international bodies with specified areas they should focus on. It is, therefore, not easy for new and upcoming women faculty of advance through publications because of limited chances for them to engage in meaningful research activities as they are limited by funding. The study, however, noted, that other universities provide grants to staff to conduct research and set a minimum number of publications that faculty should produce in a year; failure to meet the requirement results in loss of some status. For example, at the Royal Melbourne Institute of Technology (RMIT) in Australia, a member of faculty loses the professorial title if they do not publish an article in a year.
b) Sixty percent of all respondents reported on separation of work and home and 75% of respondents reported that they have problems working within the expected working hours. The study found that the nature of work for faculty couldn't be performed within the prescribed working hours as faculty end up performing some tasks beyond working hours. For example, marking of examinations/assignments, research proposals and reports; as time at the office is not adequate considering that the faculty have to offer lessons. . It is a common practice for faculty to carry their work with them wherever they go. This, therefore, results in the faculty member not allocating adequate time for family members.
c) Fifty percent of all the respondents also reported that the amount of workload has a negative impact on their ability to balance work and personal life. In relation to the aforementioned, (point b, above), some women faculty felt that the amount of work some of them perform is more than what they would normally handle to effectively advance in their career. The most frequently mentioned factors were completing tasks in various college committees and meetings in addition to normal duties such as teaching and supervising students' research. On the other hand, half of the respondents also felt that the amount of workload they have has a

positive impact on their ability to balance work and personal life. This implies that the workload is not evenly distributed among women faculty across departments.

d) Amount of weekend and evening obligations. The study found that all the four women faculty who mentioned this factor reported that they were negatively affected. As women faculty have more obligations at home such as caring for children and other dependants in addition to performing their professional duties and in some cases there are clashes in their pursuit to meet both expectations.

Whilst the majority of the factors had negative impact on women faculty, they had a positive impact on some. These include (a) support from spouses; (b) Workload; and (c) separation of work and home life. Refer to figure below for more details

4.3. Availability of Mentoring Programs

The survey sought to know whether there is a formal mentoring program at the University. All the 11 respondents indicated that there is no formal mentoring program. Due to the responses obtained from this question, it was not possible to understand how mentorship has influenced the professional lives of the respondents.

4.3.1. Factors Promoting Mentorship Relationships

The study sought to find out factors that would promote development of mentoring relationships from the respondents. The findings reveal that most respondents have similar perceptions as regards development of mentoring relationships. This is to say that 7 out of the 11 respondents thought that mentoring consists of the following: being able to access mentors

Out of these responses, access to mentors that fit their goals featured highly with 4 respondents out of the 7. This was followed by knowledge on what is expected of mentoring relationships with 2 respondents, and finally, availability of resources to support mentoring programmes with 1 respondent.

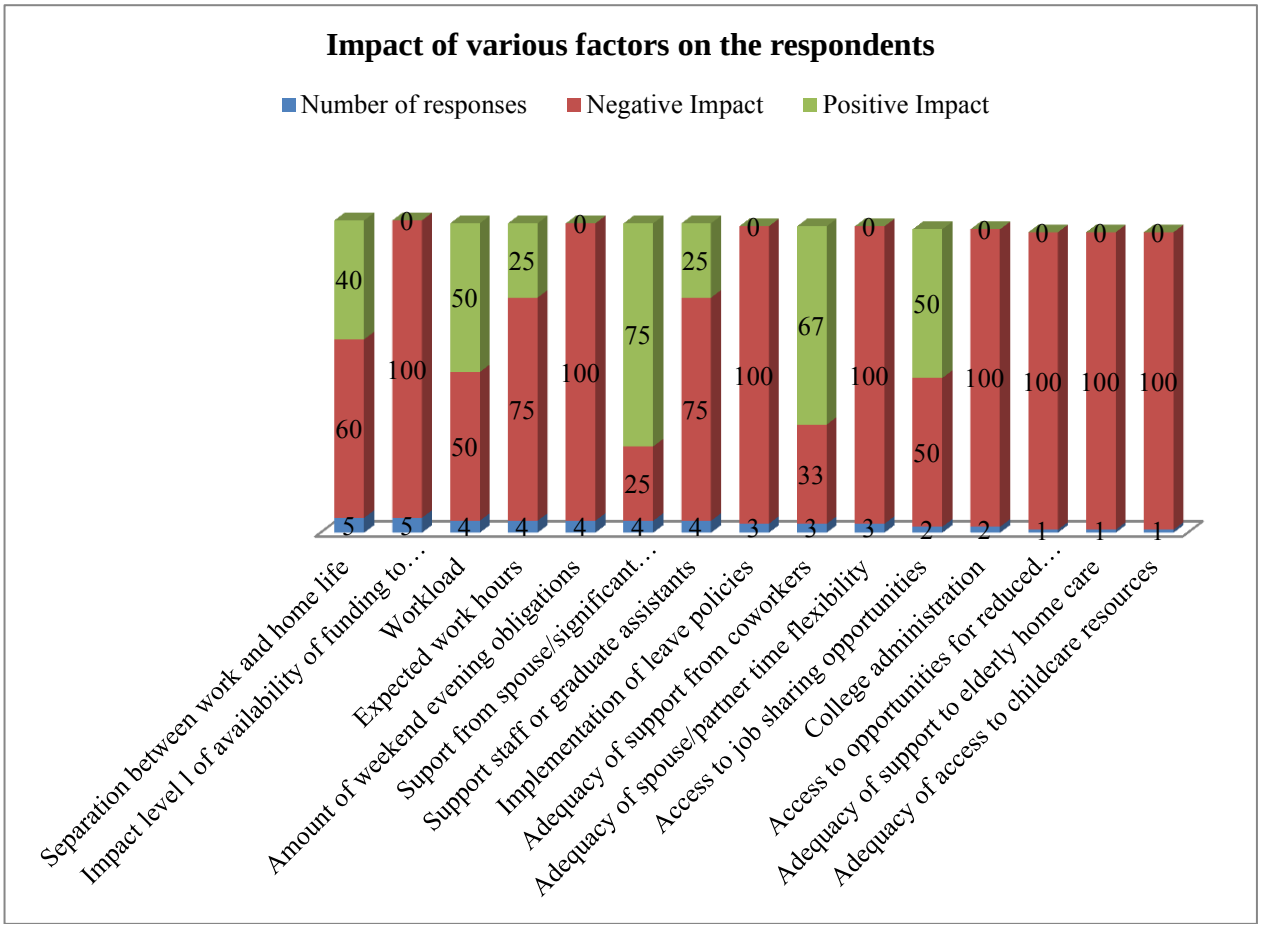

Figure 1: Level of impact of various factors on balance of work/home or personal life that fit their goals; having opportunities to develop mentoring relationships; availability of resources to support mentoring programmes; having similar research experience with the mentor; accessibility and willingness of the mentor to assist the mentee; and knowledge on what is expected of mentoring relationships.

4.3.2. Factors Hindering Development of Mentorship Relationship

Regarding factors that hinder the ability to develop mentoring relationships, respondents gave the following as reasons: lack of formal mentoring programs; lack of access to mentors that fit peoples' goals; lack of knowledge on how to initiate mentoring relationships; lack of resources for running mentorship program; lack of formal mentorship program that can be monitored objectively; unavailability of mentors and lack of trust and fear.

4.3.3. Institutional Changes to Improve Development of Mentoring Relationships

On institutional changes that would improve the ability to develop valuable mentoring relationships, respondents suggested the following: developing a mentorship program such as African Women Agricultural Research and Development (AWARD); providing funds for running and developing mentorship programs with focus on newly recruited lecturers in teaching, research and leadership skills; providing an enabling environment for the formulation of mentoring relationships; and introducing mandatory allocation of mentors to new academic staff in the system.

4.4. Policies that Address Gender

4.4.1 Knowledge and Awareness of Policies that Address Gender

One question sought to find out from the Key informants whether they are familiar with gender provisions of the Malawi Constitution. One male and one female key informant responded in affirmative. However, one gave a negative response. Those who responded in affirmative indicated the following as the provisions that they know: women's right to education; equal access to training; right to compete for any leadership position and that there is a deliberate effort to increase the number of women in decision making positions to at least 30%. Women should not be subjected to hard labour practice and that women should not be discriminated against; and they should have equal employment opportunity.

Key informants were also asked whether the provisions stated above are acknowledged and followed at the University. The results reveal that the University follows some of them; including availability of positive discrimination effort to enroll more females into programmes and that when scholarships are awarded, the University does not discriminate in terms of gender, rather on merit. However, one female key informant indicated that the University does not follow such provisions.

Further, key informants were asked whether they are aware of any policies in Malawi or at LUANAR that address gender. The results reveal that some are aware and others are not. Those that indicated that they are aware mentioned the following as policies that address gender in Malawi and at LUANAR: equal access and sharing of resources between both genders; non-gender discriminatory policies on employment and scholarship awarding. In addition, some responses referred to the LUANAR strategic plan 2012- 2017 as having some sections that address gender; these include selection of students into undergraduate programmes which reserves a certain quota for female students. This is achieved by deliberately giving places to girls who fair lower than some boys in order to increase the number of girls into the University's academic programmes; the University management is striving to get a 50/50 male-female balance in various academic programmes. Additionally, some sections in the strategic plan include provision of facilities that would support female students, such as a day care centre, which will help students with children under the age of five. Additionally, departments are encouraged to recruit female staff members even such recruitment remains based on merit.

Conversely, some key informants indicated that there are no policies addressing gender at the University.

> *"There are no specific or written down policies as such that address gender issues at LUANAR University*." Key informant interview, June 2013

> *"There is no Gender Policy at LUANAR."* Key informant Interview, June 2013

However, the management encourages women in various ways such as applying for scholarships and jobs at the University and increasing the enrollment of female students. The results reveal that at some point, when the University was one of the constituent colleges of the University of Malawi, there were plans to introduce a Gender Studies Unit. However, it was not implemented because Chancellor College had a similar unit and that it was seen, apparently as duplication.

From the results, it is clear that there is conflicting information and misinformation on the existence of a policy that addresses gender at the University. Some indicate that the university has a policy, yet others say there is no such a policy. This is further demonstrated by the following remarks from some key

informants who indicated that Deans of Faculty are charged with the responsibility for administering some of the policies such as during selection of students in to undergraduate programs. Others indicated that the LUANAR strategic plan and LUANAR conditions of service give certain university officer the responsibility of administering the policies. Further the female key informant surmised that the policies have been effective in reducing gender discrimination to some extent since they have helped to retain women in the University system which has impacted positively on female students on the campus. For example, female tutors who have somehow managed to mentor some female students and to help keep them in school.

The conflicting information on the existence of Gender Policy at the University is partly due to the fact that the University management is making efforts to address gender gaps amongst academic staff and students. This visible effort gives the impression that there is such a policy. However, most of the activities and efforts are implemented without system or written guidelines. This means that such efforts are unsustainable as they proceed from undocumented or poorly documented policies. It is important to note that, the University does not have a policy that addresses gender which makes it difficult to sustainably address the gender gap.

4.5 Challenges and Barriers in Career Development

4.5.1 Challenges and Barriers Related to Gender

Key informants were asked if they have encountered any challenges or barriers related to their gender in their career advancement. The male key informants indicated that they have never had any challenges in their career advancement that could be related to their gender.

4.5.2 Strategies to Overcome Challenges and Barriers in Career Advancement

The study sought to find out whether staff members have developed strategies to help them in advancing their career and overcome challenges and barriers in career progression. One such strategy that informants have used is to network with institutions of higher learning and individuals. This has been possible by grabbing any opportunities offered, for instance, when attending international conferences, and meetings. According to the key informant, these forums, offer opportunities to find women role models through interactions. In addition, hard work was reported as one strategy. According to the key informant, sometimes men take more leadership positions because of hardwork as women sometimes fail to perform to the expected levels.

4.5.3 Assisting other Staff Overcome Challenges

Key informants were also asked whether they have attempted to mentor others to help overcome their challenges and/ barriers**.** Some responded in the affirmative. The following were the examples of mentoring they have done to help others overcome their challenges and/ barriers: supervising a woman at a doctorate level; offering a senior position to a woman even though she did not take up the position; rendering supportive assistance to female members of staff who are in one of the male-dominated departments, and role modeling to female secondary school students as a female teacher in a science subject at a co-education secondary school. According to the key informant, the results of this were seen within a short period as girls out-performed boys for the first time. Also indirectly, she positively affected female students at the University sometime back. When she started lecturing, female students' grades improved noticeably in the first semester.

4.6 Gender Climate for Women Faculty

The study explored the climate for women faculty from the perspectives of the women faculty and key informants through a number of questions. The women faculty responded to questions on factors that affect their lives as women and whether the climate at the University supports them in reaching their professional goals. Key informants were asked to describe the general climate for women at the University. The study registered mixed results on the climate for women.

4.6.1 Factors affecting women faculty

The women faculty mentioned 9 factors that have impacted on them as female members of staff. These are: appreciation of their work and efforts, supportiveness of co-workers, number of women in management positions, college resources in general, amount of work/time pressure, opportunities for career development, relationship with their supervisor/superior, equity issues, and physical work environment. They are listed in order of frequency from the most to the least (Table 4).

Table 4: Factors affecting women faculty

Factor	Frequency	Impact Level			
		Very Negative	Negative	Positive	Very Positive
Opportunities for career development	5	0		4	1
Equity in general (e.g. salary, promotion, confirmation, human resource policies, etc.)	5	1	0	4	0
Relationship with your superior/supervisor	5	0	1	2	3
Physical work environment	4	0	1	2	1
College resources in general	6	3	2	1	0
Amount of work/time pressure	6	1	2	3	0
Supportiveness of coworkers	8	1	3	3	1
Appreciation of my work and efforts	8	1	4	2	1
Number of women in management positions at your College	7	1	6	0	0

Factors that impact women positively include availability of opportunities for career development in terms of promotions and training; good relationship with the supervisor; equity in salaries and promotions; and physical work environment. Although the women generally rated the later as positive, 4 women bitterly complained about the lack of facilities for sanitary disposal and a day care centre at the University. This was perceived as lack of support for women in general. To help us understand the sanitary disposal issue, this is how one woman has experienced it:

> *'… as a female lecturer, when toilets have no bins, what we do is to take the used pads/tampers – you just put them in the hand bag to throw away at home. If you stay in town these things are in your bag all day'. [Source: woman faculty member, questionnaire]*

Compounding this issue is the fact that there is a fixed transport arrangement. The College bus picks up staff from town at 7am and leaves the College at 4.30pm.

Factors that impact on the women negatively are lack of appreciation of work and efforts, few women in management positions at college, and inadequate college resources in general. The major issues under lack of resources include inadequate teaching materials in the classroom/labs and inadequate funding in general. The women staff noted that male dominance in management positions means that contributions to decisions were mostly made by men. There are few women in all faculties, a situation that makes it difficult for women to compete equally for leadership positions during elections. However, there were equal numbers in terms of negative and positive experiences in relation to supportiveness of coworkers and amount of work/time pressure. Some women reported the lack of networking and mentoring opportunities as an important negative factor while others benefit from collaboration with other colleagues. Due to differences in their roles and responsibilities at work and office, amount of work and time pressure are different.

4.6.2 Support for women in reaching their professional goals

Five out of 11 women believe the climate at the University supports them in reaching their goals while 3 do not. However, three other women were not sure. The presence of a deliberate supportive environment for women advancement based on merit was the major reason given by those who answered in the affirmative. They cited the availability of training opportunities targeted at women, the deliberate measures put in place to make sure women who do well during interviews and inclusion of women in some committees and task forces.

Among the negative factors, respondents pointed out factors such as inadequate support in terms of resources for teaching and research as stated above, lack of formal mentoring opportunities, an uncertain academic calendar, dominance of men in management positions, and heavy workloads. The academic calendar has been tentative for the past three years due to disturbances by students' strikes. As a result, both male and female faculty have not been able to take their usual long holiday at end of the academic year.

4.6.3 Views about the general climate for women

Key informants were asked to describe the general climate or environment for women at the University. Their responses were mixed and revealed three different scenarios. The first scenario is that the University has supported women and strives to achieve gender equality and equity. This view was based on the deliberate policy to increase population of undergraduate female students from 7% to 40% and the fact that leadership positions are open to both men and women as long as they qualify. In addition, respondents argued that although there was no affirmative action for recruiting women, management has made deliberate efforts to increase recruitment of women from the current 15%. It was reported that management encourages departments to recruit women and advise interview panels to pick a woman if she competed equally with a man. As a result, there is at least a woman in every department currently except in the Department of Agricultural Engineering. However, the key informants noted that most women do not have the relevant qualifications and experience for the management positions such as head of department, deans of faculties and Vice Chancellor. As a result, few women apply for these positions whenever they become available for filling.

On the other hand, it was observed that despite this support, some women decline leadership positions. That is, they refuse to apply or accept leadership positions and this tendency further reduces the chances of women getting into management positions. In addition, some women do not want to take

up challenges expecting to receive advancement through affirmative action. A concerned male key informant said:

> *In many cases, they [women] don't want to engage more seriously in discussions, including research, even to develop their own concepts and proposals and fight and argue with men. This needs to be worked out. Because, there is no difference in terms of capacity between men and women. Women can develop their own proposals and argue out in public forum. … At times, there is a tendency among women of expressing this in terms of: 'this was done because I am a woman; they did this because I am a woman'. Usually this is said when there is a question or criticism.*

The above situation points to a need for such women to improve considerably and strive to be at their best in all they do – be it research, teaching or management. It also suggests the need for capacity building in leadership and proposal development for these women.

The second scenario is that the climate of women has just started to improve and there is much work to be done. For example, there is no woman in management apart from the Dean of Students, which puts women faculty at a disadvantage. Sometimes, a woman is brought in as an afterthought. Three different key informants put it in this way:

> *'This is a big disadvantage in that certain issues require a gender perspective and if women are not there, men may not consider or articulate these issues.' [Male KII]*
> *'Men do not see the fine lines.' [Female KII]*
> *'Women are not involved in the planning processes and last minute inclusion of women tends to exclude them in these planning processes.' [Female KII]*

Women are also absent in social clubs where men interact and make decisions as illustrated in the quote below:

> *'Men tend to form their own social clubs because of social and cultural barriers. Decisions are made in these social clubs and therefore women are denied participation in decision making processes and remain behind'.*

On campus, there is a senior staff common room where women faculty are virtually absent due to socio-cultural barriers. The above situation suggests that for the most part, the voices of women in decision-making processes are not heard at this University. It emphasizes the uniqueness of men and women and the importance of having representation of each gender category in order to address the gender needs.

The third scenario is that the climate of women has remained stagnant. This view is based on the fact that the University has not taken an interest to address gender needs of women that would improve their work lives. The key informants expressed the following concerns:

- Women need to work extra hard to get their demands through with the administration or to justify their position, especially when male members occupy senior positions
- Multiple roles played by women are not considered if women are in management positions.
- Women that are in leadership positions are not supportive and are not accessible, especially to young women faculty..
- There are practically no social amenities for women in general and in particular, for nursing women and those with young children. Sanitation facilities are far apart and unhygienic. This is of particular concern particularly because as note earlier, most of the women are young professionals in their child bearing age. To make it worse, the only social club (senior

staff common room) available on campus is virtually inaccessible to women due to existing cultural barriers that results in the dominance of men. One KII explained:

> '*… the services are mostly for men, for example, the senior staff common room. Women have no such places for relaxation and have no chance for social interaction. Because of this, they may fail to know some issues as fast as the men may. During such interaction, many issues come up, even those to do with work'*. [Male KII]

These examples suggest that the gender needs for women staff are not being considered and a gender policy was called for.

4.7 Communication and Access to Information

Effective communication is important for management and productivity of organizations. The study collected information to determine availability of various means of communication in the university.

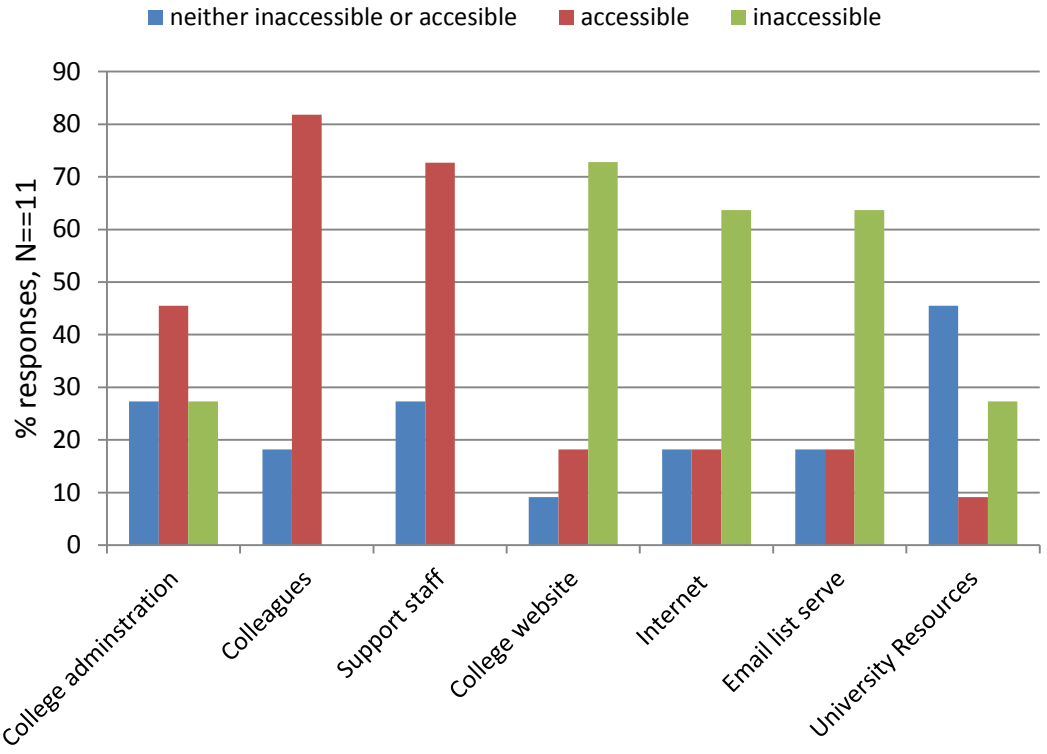

Figure 2: Access to different sources of information at the University

The results show that colleagues and support staff are generally accessible. However, respondents indicated that the college website, internet and email list serve are inaccessible. The information to be included on the University website should be informative (needs great improvement) and updated and this should also include the history of Bunda College. The university resources such as newsletters, flyers and brochures are sometimes accessible and at times not accessible depending of the type of information required.

The study further explored availability of college administrators to female faculty members. It was found that 55% of respondents felt that college administrators were not accessible. . Other concerns raised

were related to bureaucracy of administrative offices. Additionally, it was noted that top-down approach in communication is not conducive and it result in delays in communication.

> *"The university should improve communication: especially the problematic record keeping by administration; students trends by gender by program; development partners who have assisted the college; information on history of the college and internet, email, college web site university resources needs great improvement"*

In terms of availability of information to faculty, it was noted that the key challenge is access to students' records such as students' class list; examination information, and decoding sheets.

In terms of availability of various library resources findings from key informant interviews indicate challenges with access to library resources for teaching and research. Some of the challenges raised were related to access to peer reviewed journal articles and books. Respondents indicated that:

- there are inadequate teaching resources, poor access to latest academic journals and books in some areas;
- books take time to be purchased.
- inter library loans take time to be processed and sometimes books arrive when the course is completed.
- poor access to internet resources and most members use own resources to access internet.

4.8 Job Security

The study explored the level of job security by the respondents. The study defined job security as the probability of a staff member being fired from his/her position.

Respondents were asked of factors that affect their job security as a female staff member and the impacts level was rated using a scale of 1-5, with 1=very negative; 2=negative; 3=positive; 4=very positive; and 5=not applicable. From the findings, job security is not a problem for almost all the female staff members at LUANAR. All the women faculty and staff interviewed were on permanent appointments. Some issues impacting on job security were raised by respondents (Table 5) including the following: availability of release time from teaching for research/administrative work (2 out of 9) and this can be negative or positive; flexible work hours (1 out of 9); low number of students enrolled in the program (1 out of 9); lack of experience in research and less involvement in research teams (1 out of 9); department management systems (1 out of 9); and lack of knowledge on confirmation process (Table 5).

Table 5: Factors impacting on job security as a female staff member

Factor	N=9	Impact level
None	3	-
Too much workload, no release time for research	2	Negative (1), positive(1)
Flexible work hours	1	Positive
Permanent employee	1	Positive
Low number of students in the program	1	Negative
Departmental management systems	1	Negative

Conformation processes (not sure on how people are conformed as I don't have a letter of confirmation)	1	Very negative
Mutual respect in work place	1	Not specified
Equal opportunities and remuneration befitting the type of work done	1	Not specified
Motivation and being appreciated for work done	1	Not specified
Less active in research because of inexperience and not being involved	1	Not specified

4.9 Promotion

Promotion in the University for academic and administrative position include rising through the academic ranks and/or holding management position in the University. The findings from this study show that the criteria for promotion, experience, networking and self determination are some of the factors that affect the advancement of women in the University.

- **On the criteria for promotion**, all the key informants indicated that gender has no effect on promotion in the University because the criteria for promotion of faculty members are the same for men and women. Some key informants also commented that publishing academic papers for promotion purposes can be quite a challenge for women especially those with families and young children. These have to balance professional responsibilities with family responsibilities. One of the respondents said that "*Regardless of challenges there between men and women, criteria for promotion are the same. Because of that, most women are not promoted. Men can stay here on campus to write these papers until late, but women, especially those with families and young children, it is difficult for them to stay until late and come during weekends on campus to write papers. These challenges are not seen as such by the academicians. They think women and men have a level playing ground. That is, outside the academic world, these issues do not count. These challenges may contribute to few women being promoted compared to men.*
  As was suggested earlier on some of the challenges faced by women could be reduced if the University provided social amenities such as child care facilities to improve the work climate for women as one respondent noted:
  "The University should recognize the multiple gender roles of women staff, especially reproductive roles and therefore build or extend the nursery school to provide nursing space for female members of staff."
- **Expectations on research and resources**: Research is one of core responsibilities for faculty in the university, and greatly influences faculty's advancement through the ranks. It is a requirement that one has to publish in refereed journals to be promoted. However, there are a number of challenges that women faculty face in pursuit for research and publication including limited resources (and time) for research. The study found that specific challenges of women are as follows:
  a. Women play multiple roles that limit their allocation of time for research and publications.
  b. The criteria for promotion do not include teaching but much time is invested preparing lessons. For some the teaching load is quite heavy.
  c. The University does not provide start up research funds to faculty members. Even though this affects all faculty, women are affected more than men as they have limited time for writing research grant proposals due to the multiple roles they play at home and at work.
- **Women in management positions:** The management position at LUANAR are the Vice Chancellor, Deputy Vice Chancellor, Faculty Deans, University Registrar, Directors of Research Centers and The Director of Finance. At the time this study was conducted, there was only one woman in a

management position. Thus, women may not be adequately represented especially when lobbying for changes in the face of challenges faced by women faculty and administrators.

- **Expectations of women from fellow women in management positions:** Some women expect good representation and support from fellow women in management positions. That is why some of them expressed dissatisfaction in that the some women in management do not represent the interests of women and are sometimes inaccessible. One of the comments from the interviews seems to suggest the women in management positions are hardly visible because of the few numbers in relation to number of men.

"*Even women in management positions behave like men, that is, they don't take the interest of fellow women on board, or they are not reachable)*"

Another point raised was that some women are less supportive to a fellow woman in management positions than men. *"Sometimes women refuse positions, women pull each other down. This happens even among women who are educated. You see a fellow woman trusts a man more than a woman."*

- **Willingness to take up management positions:** In the University, there are criteria for promotion, election or appointment into leadership positions. In addition to satisfying the criteria, all these positions require the willingness of a staff member to apply for the position. While the number of women in management positions is lower than that of men, experienced managers both women and men indicated that women sometimes refuse to take up management/leadership positions when appointed or when opportunities exist. Some of these positions help in building leadership skills and the experience can be used as a ladder to higher management positions. Specific examples mentioned were in the election to the positions Head of Department or Dean of Faculty.
- **Self-determination and hard working is key to achieving the set goals.**

  "There is a perception that women have: this is that women don't want to take challenges, they wait to be treated as women, with a soft touch. In many cases, they don't want to engage more seriously in discussions, including research, even to develop their own concepts and proposals and fight and argue with men. This needs to be worked out"

  "*Women should stop thinking as women at work place but should think as professionals. The University should look at members of staff –as staff- (not men/male and women/female staff) based on professionalism"*
- **Experience in administrative/leadership positions such as Head of Department, Dean of Faculty:**

  "*My own qualities as a Professor and experiences as Dean of Faculty and Head of Department and other work with outside Universities and other organizations"*
- **Ability to collaborate with other scientists:** Research requires collaborative work with other scientists (local and international institutions) and therefore the ability to work as a team and develop professional networks is important; and being open to learning.

  "Personally, I work hard and perform. Men take these other positions because we sometimes fail to perform to the expected level. So I have taken an effort to develop myself in these soft skills."

  "I work very hard; I put all my energy and knowledge into my work to ensure good result. I am a perfectionist and so I want to do things right. I am focused; I don't want to be distracted from what I am doing until I finish it. Be focused and don't look back, even if people are saying this and that, do not focus on the distracters, just ignore them and what they are saying otherwise, you will not get where you want"
- **Networking with influential people** can help in career development and promotion, for example, networking with government officials, politicians, donors and other scientists through national and international conferences and meetings.

"I network with influential people. For example, for the farm, I networked with the tobacco and seed industry to see how they can help us. For widening access, I networked with government officials, parliamentarians and donors, and showed them what we are doing and our challenges."
"I have taken advantage of international conferences, meetings I attend as opportunities for networking and finding role models. I have met women who have impressed me".
"I saw Bunda as a place to develop a professional academic career. So first, I had to make good connections. I had to network with important people and organizations like RUFORUM which offers training and scholarships. I attended meetings and met important people who would help me develop my career."
"Male members of staff in other departments used to team up and do group publications but could not do so with women."

- **Formal and informal consultations:**
  "I consult – formal or informal – to find out what others are thinking, to get people's ideas. I am a team player. I don't want to get credit alone, but collectively. But I do provide direction when working with people, and get input from others. This is how I managed to put things together to get LUANAR in this transition phase within a short time. You can't do these things alone, but I had the vision, so I put up a number of task forces and staff worked hard to get where we are today.
  "I always look at how to do things better, so I go around to see how others are doing things and reflect on that and try to improve on what I am doing."
- **Good relations with people for elected positions:** Previously, Deans of Faculty and Heads of Department had to be elected into the positions and those with good public relations were likely to be elected.

4.10 Experiences in Teaching, Training and Research

The findings show that half of the key informants had no role models to look up as they pursued graduate studies or their academic careers. This was expressed more by female key informants. This gap was felt more by the female participants as the men could relate to the males that were present on campus. It is not surprising that the lack of female professors at Bunda who would act as role models and mentors is a necessary need.

The study found that the University does not provide seed grant for conducting research making it difficult to start up research activities. Those who have been successful have used the academic environment and being an employee of the university as a facilitator to securing resources and hence getting access to research.

The male key informants reported that in their early careers they had been under the wing of a male mentors and role models in most instances who mentored them in proposal writing as well as the delivery of lectures. This a major gap for women unless addressed will always hold them back. There is no difference in terms of capacity between men and women. Women can develop proposals just like men, as well as actively participating in public forum. However, at times, there is a tendency among some women of expressing that they are treated differently because of their sex. Usually this happens when there is a question or criticism.

4.10.1 Challenges experienced as a woman/man with research, training and teaching

The basic challenge reported by both male and female respondents is the lack of resources in general to enable research, training and teaching to be effectively done. However, in general, men reported that this was not a major challenge.

Management positions, combined with teaching, results in a heavy workload. However, being an academic requires that one to do research and publish for upward advancement through the academic ranks. Consequently, female faculty have major challenges in balancing work/personal life. There is a need to improve considerably on the part of women; to be at their best in all they do, whether it is research, teaching and even invigilation. Sometimes, women may not be able to take up certain tasks due to family obligations. The experience in Malawi is that most Malawian men do not take up domestic chores due to cultural expectations.

4.11. 1 Personal Safety

In response to the question of safety on campus, 54.5% of the 11 respondents felt generally safe with only 27.3% of them feeling very safe as Figure 3 below indicates. The reasons safety concerns were linked to periods when students are rioting during their demonstrations or strikes, inadequately patrolled forest reserves around the campus especially those close to the campus buildings and lack of smoke detectors and fire extinguishers in buildings.

The situation is similarly reported when it comes to academic/classroom locations on campus as shown in graph below where generally the respondents found the academic environment to be safe during work hours. This was attributed to the fact that areas are always highly populated with visible security personnel. The relative small size of campus was also given as a reason as it gives a sense of security.

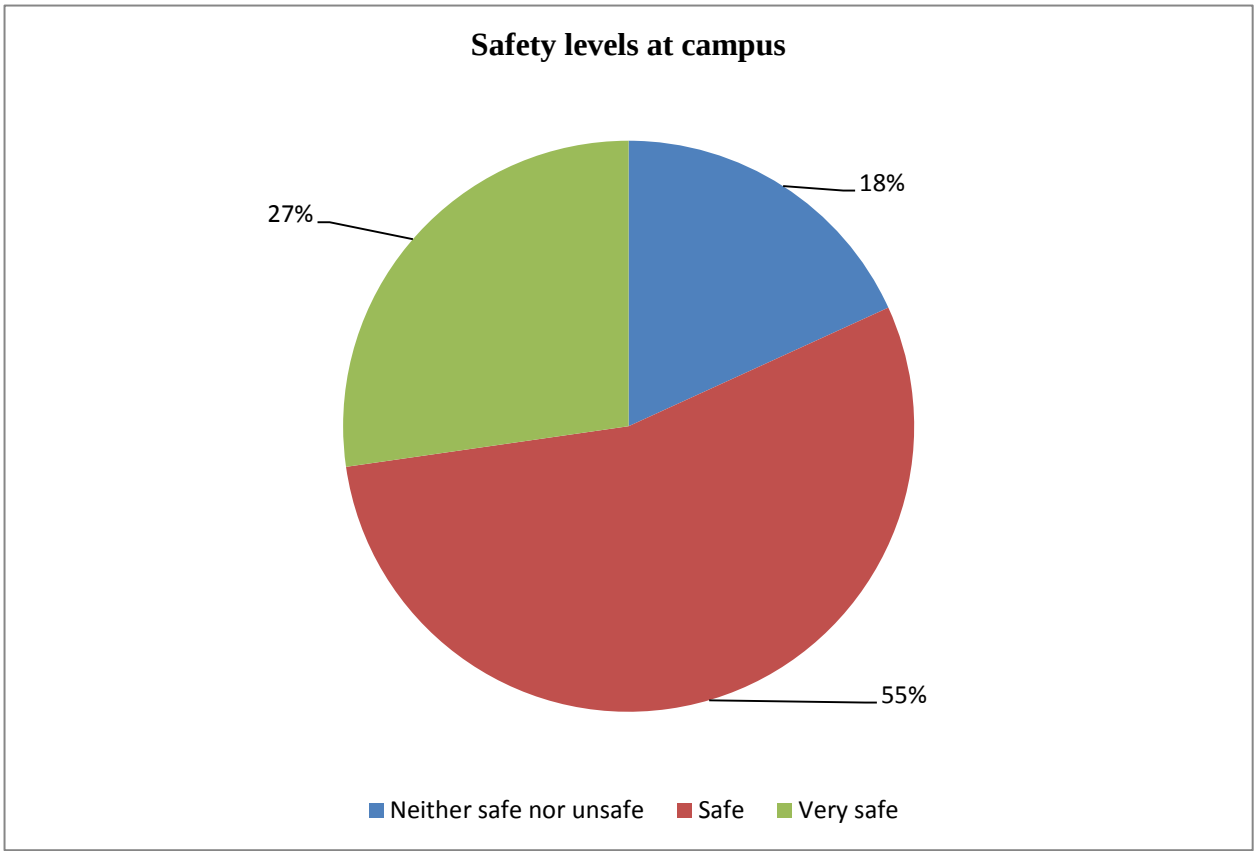

Figure 3: Women faculty perception of personal safety on the campus

During the day, office buildings and off-campus areas were reported to be the safest place. However, college surrounding areas were reported to be the unsafest place. This might be attributed to the

biophysiscal set up of Bunda College where there are many forests surrounding the campus. The environment is not very positive though after working hours as shown in the graph below.

During the night, off campus activities and office buildings were reported to be the safest places while college surroundings and campus pathways were reported to be unsafe. Summing up the results, it is evident that the biophysical surrounding of the college i.e. presence of forests is a factor to be weaved in considerations to improve safety. Thus, issues of proper lighting and presence of well trained-security guards are recommended.

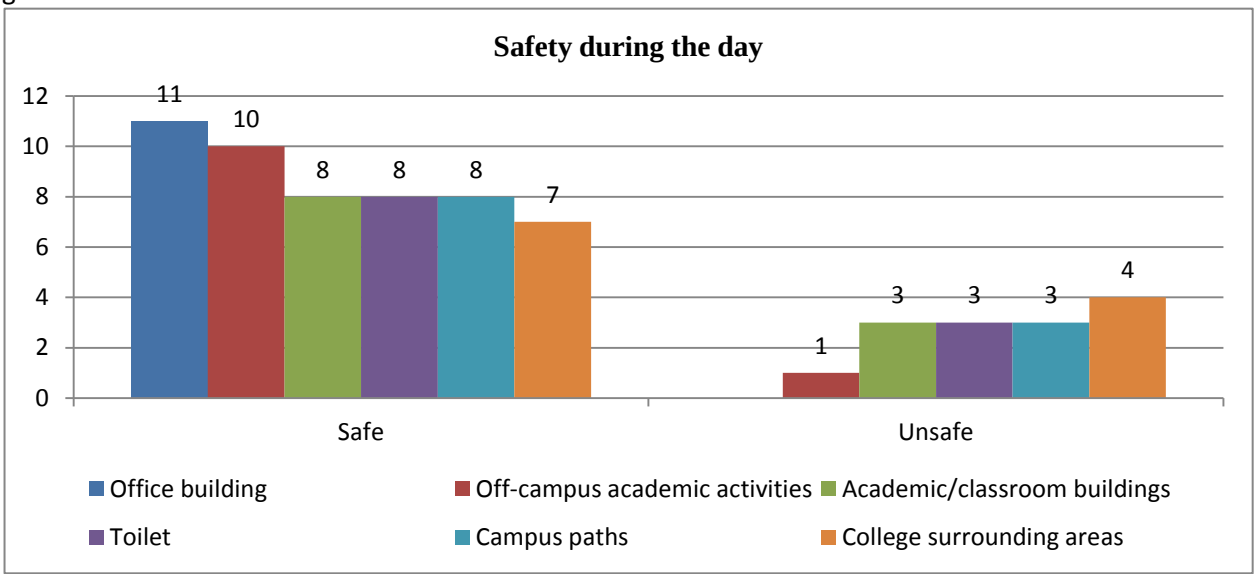

Figure 4: Women faculty perception of safety on campus during the day

Regardless, suggestions were given in order to enhance the security and safety on campus. This was felt as necessary particularly if working off hours and as the population increases on campus, as well as a general safe environment on campus. The suggestions ranged from provision of a hotline to call in times of need of help and, provision of student security during students' demonstrations. LUANAR management should also consider installing extinguishers, smoke detectors, as well as first Aids kits the laboratories., The safety of the laboratories is crucial for the safety of both staff and students as well as avoiding fire hazards such that staff working in laboratories should be exposed to a course in working the laboratories and be certified.

The respondents also felt that properly trained professional security personnel would enhance their safety. It is apparent now that most of the security guards come from the locality surrounding campus with no training. The provision of clearly demarcated pathways between buildings would also enhance security and increase the appearance of the campus environment. An attempt to have good security lights should be enhanced.

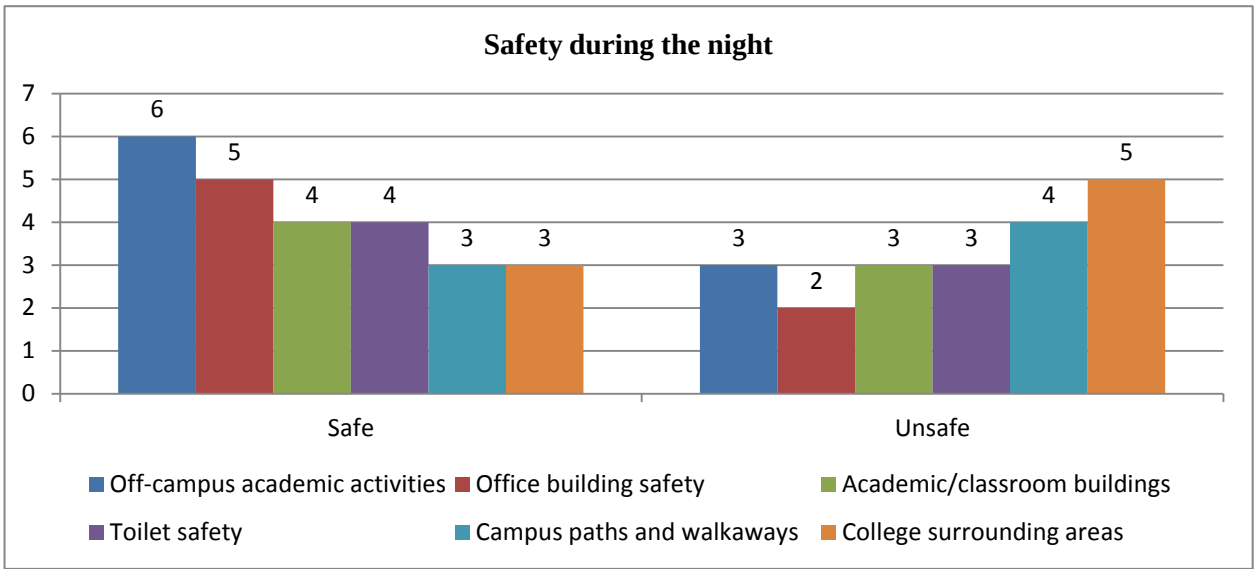

Figure 5: Women faculty of safety during the night

The picture is reported as not conducive as regards safety of the campus surrounding areas during working hours where 36.4% reported them as unsafe with 18% rating them as very unsafe after work hours as below. These findings follow a similar trend in responses to question on them identifying areas on campus and situations where they felt unsafe as in table below:

Table 6: Rating of campus areas & situations felt as unsafe

Area situation	**N**	**%**
Car park	1	9.1
College bus	1	9.1
During a blackout	1	9.1
During students strikes/riots	6	54.5
Forest	2	18.2
Total	**11**	**100.0**

Another area of concern as to personal safety involved toilet facilities where the general picture was noted as of them being safe during day time but their safety drops after working hours. This was explained as to access to toilets where their location requires a stretch of a walk and maybe out of a building which becomes a challenge during the night.

CHAPTER FIVE
DISCUSSION

6.0 Introduction

The above presentation of findings opens opportunities to discuss the problems affecting women faculty at the LUANAR. Keys aspects that demand further exploration are the social and cultural contexts from which these findings arise. This is of particular importance because some of the findings can very easily apply to men faculty as well. Thus, the challenge here is to discuss how these problems are uniquely negative to women faculty. Further, the chapter will examine other factors regarding professional advancement for women and make recommendations for the university. However, before delving into

these, it is important to examine some methodological consideration that may unnecessarily colour people's perceptions of the findings

6.1 Methodological Consideration

Some critical questions may arise regarding the methodological followed in implementing the study that gave rise to this report. Unfortunately, this may result in readers foregrounding the report with the methods thus taking away from what are critical findings regarding the climate for women faculty at the university. The rationale for the methodological considerations has already been given in Chapter Three of the report. The small sample that responded to this study could be the sticking point. Suffice it to emphasize the exploratory nature of the study and the availability considerations of the study. However, the assumption here is that readers will accept that this study is an exploratory, and that, in the qualitative study tradition, these study represent characteristics of phenomena that demands further exploration with a bigger sample and quantitative methods.

Apart from the sample, other readers may feel compelled to argue that these findings also describe the problems faced by men faculty at the university. Indeed the first part of this chapter concedes this aspect. However, when viewed against the traditional background under which faculty - both men and women – operate, it becomes clears that women faculty are at a distinct disadvantage. Thus, the findings take on a special meaning for women faculty.

These interviews were conducted with women who were asked to provide life experiences of being women faculty at a university undergoing change from being a constituent college of a university to a full independent university. Thus, the findings, no matter how generic they may appear, apart of the lived experiences of women faculty demanding solutions directed at alleviating their negative effect on women faculty.

6.2 Traditional Society and its Impact on Women Faculty

As noted in the literature review chapter of the report, studies on the professional climate of women academics in Malawi are lacking. In this regard, this study is ground breaking for Malawi. It exposes some of the factors that contribute to women faculty discomfort which may lead to lack of professional growth. In a country whose population is over 50% female, it is important to be aware of the problems affecting women in every facet of life including academia. It is quite easy to view the findings presented in the preceding chapter as a set of factors which may apply to both women and men faculty. However, in view of the male domination in Malawian academia, and in view of the tradition social context in which women faculty work and the university operates, it is important to note that these factors have an even more negative impact on women than on men. For example, the problem of security and threats to personal safety mentioned above apply to both women and men. However, women are more vulnerable to security problems and threats to personal safety than men who are seen as being better able to take care of themselves. Women, on the other hand, are viewed easy targets for violent crime, especially sexual violence, because their upbringing does not normally prepare them to react to violence on equal terms. Similarly, the question of research and promotion may seem to apply much in the same to men and women.

The above notwithstanding, it is not easy for women academics to spend as much time as their male colleagues at the office preparing research proposals for funding or indeed writing papers for publication. Traditional society expects a woman to spend time at home in her nurturing role supporting children and making the home comfortable for the man of the house. Indeed, it is expected for the man to spend as much time as possible outside the home in his traditional role as the provider for his wife

and family. Thus, even though, the promotion criteria for academics applies equally to both men and women academics, the women faculty face an extra challenge in meeting this criteria as they have to balance their professional roles with the traditional nurturing roles expected of them at home. In this respect, that is why issues of security, promotion and the length of working hours take on more enhanced meaning as far as women faculty are concerned. In short, even though men and women faculty work within the same professional context, traditional roles impact heavily on the conduct and productivity of both men and women, with women feeling the negative impact more than men. The above assertion is by no means peculiar to Malawi. As noted in the literature review, Ogbogu (2013) notes that women faculty in Nigeria tended not to take up scholarship to the doctoral level in order not to compromise their role as nurturer on the home front. Further Ogbogu (2013) also notes were resigned to the fact there were no policies within universities that make it possible for them to properly balance their role as nurturers at home and as professional academics. Hancock, Middleton, Moore & Edirisinghe (2011) noted a similar problem in Sri Lanka and observed that differing traditional roles between men faculty and women faculty make it difficult for women faculty to take advantage of opportunities offered by gender mainstreaming in Sri Lankan universities.

However, as Hancock, Middleton, Moore & Edirisinghe (2011) argue, mere gender mainstreaming may not be the answer. In fact, as Hancock, Moore & Edirisinghe (2011) note, gender mainstreaming can negatively present women as victims not positive contributing agents in the operation of universities. Thus, this study argues for the removal of some organisational structures within the university that may work to the detriment of women faculty who are trying to balance their professional roles with their home life. Factors such as the positioning of toilets and security can be included in future plans for infrastructure at the university. Further, questions of scheduling classes and transporting staff from town to the university and back, can be dealt through proper planning and investing in not just one transport vehicle but two or three.

6.3 Numbers and Professional Advancement

This study observes the low number of women faculty in the university. This fact is exacerbated by the fact that LUANAR is, by and large, a university specialising in the application of biological sciences to agriculture research and teaching. The academic field of science is generally viewed as a male domain. Indeed, in primary and secondary schools, girls lag behind boys in their performance in the science subjects. Thus, the low number of women faculty at LUANAR is part of a world-wide phenomenon as Ceci & William (2010) observe. Even in developed countries such as Australia and Sweden (Bennett, Salo & Dosekum, 2007; Hjerm & Dannel, 2013).

The LUANAR has taken firm step to redress this imbalance between women faculty and men faculty is commendable. It is something that women faculty acknowledge and appreciate as reported in the findings of this study. Indeed, for some of the respondents in the study, the university offers them job security which they appreciate. In this respect, the university is ahead of other employers. The university should build on this goodwill by formalising some measures that are already in place in the hiring and advancement of women faculty. For example, as the study also notes, there remains some confusion on some of the measure the university has put in place to address the shortage of women faculty. This is mainly because these measures applied in an ad hoc, and some of them are not established policy. Even as the above observation is made, it is important to acknowledge, as the respondents of this study note, that there is no discrimination against engaging women faculty. In fact, the LUANAR seems prepared to go out of its way to recruit women faculty. In this respect, it is important to encourage the University, as Hjerm & Dannel (2013) as urge for universities else, to properly organize policies, resources, rules and regulations governing the hiring of faculty to be useful guiding instruments in the

identification, hiring and professional advancement of women faculty. For example, networking within the university is important for collaborative work. However, the lack of a formal policy on mentorship makes it difficult for young women faculty to learn from their more experienced male colleagues. As the study as noted, lack of knowledge of what constitutes a mentoring relationship and the implementation of such collaboration is to blame for this state of affairs. The university will benefit by putting in place a policy for mentorship for all faculty members – women or men.

6.4 Women in Senior Management Position

The study notes that there is only one woman in LUANAR's management staff – the Dean of Students. This is not, however, to say that no woman has ever taken a more senior position than that in the past. Indeed, when it was still a constituent college of the University of Malawi, the college enjoyed the services of a woman as Vice-Principal between the years 2000 and 2004. However, there is need for the university to take deliberate steps to raise the number of females in management positions. Indeed, as the respondents argue above, such measures should not just be affirmative action for the sake of including women in management. Rather, these should be meaningful steps that provide women with the wherewithal to meet the demands and rigours of management positions.

In this respect, mentorship and in-service training can play a big role. As the respondents point in the preceding findings sections, hard-skills are just as important as soft skills. Things such as acting as a team player, flexibility, effective communication, problem-solving skills and resourcefulness, confidence, and creative thinking can best be achieved through networking and mentorship. The university must strive provide such skills to women faculty so that they can gain confidence to seek, accept and execute management offices.

CHAPTER SEVEN
CONCLUSION

7.0. Conclusion

In conclusion, the findings presented in this report show a level of consciousness among respondents regarding their status of being women in the university. The narratives are necessarily imbued with problems associated with their status as women and professional academics. While others may argue that these problems could easily apply to both men and women faculty, it is important to note that given the traditional social context in which these women live and work, the stated problems have a far more negative impact on them.

Further, it is to be noted that the university has made stride in addressing the low numbers of women faculty but that measures used need to be formalised. Further, the university need to provide structures that will enable women faculty to positively exploit the opportunities offered by the university. For example, mentoring relationships with experienced faculty can to the acquisition of skills, including hard skills and soft skills, needed for women faculty to succeed. Further, The university should take care to closely examine implications of health and safety in its infrastructure plans. Other issues raised by the women faculty call upon university management to carefully consider issues of timetabling of classes and transport issues to enable women faculty to more efficiently balance work and home life.

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An assessment of Gender Climate at Chancellor College

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March 2014

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Abstract

This baseline study sought to investigate the gender climate at Chancellor College, the main constituent college of the University of Malawi. It focused on the assessment of the recruitment, promotion and office environment among others using gender lens. The study used a mixed method design combining quantitative and qualitative research approaches. It involved the use of questionnaires, interviews and focus group discussions. A total of 58 respondents participated in the study. The main findings of the study are threefold: firstly, the study found that Chancellor College has no deliberate policy that promotes the engendering of management positions and for recruiting staff. The result of this policy absence is the male staff domination of management positions. Secondly, it was found that tradition and practice propelled college management to recruit more females for positions of secretaries and more males for positions of messengers. Thirdly, gender considerations in the recruitment and professional development of academic staff were found to be ambivalent.
Based on the results, this study makes three salient recommendations. Firstly, the study recommends the formulation of deliberate policies to ensure a more gender balanced staff recruitment for both academic and non-academic positions. Secondly, it also recommends revision of the promotional criteria for clerical and technical staff to ensure objectivity in the exercise. Despite the fact that the present promotion criteria are based on merit, there is still need for a more transparent process of setting benchmarks for promotion. Thirdly, the study recommends that annual budget lines for professional development of members of staff should reflect the strategic development plans of respective departments.

Key words: gender, gender climate, Chancellor College, UNIMA

1.0 Introduction

A baseline study was carried out to assess the gender climate at Chancellor College with the aim of engendering working conditions for staff in the University of Malawi. More specifically, it sought to identify gender related obstacles and opportunities for staff professional advancement within the University of Malawi. The study focused on both academic and non-academic staff. In this study, academic staff mean those involved in lecturing and research while non-academic staff members are those who provide support services.

This paper is divided into five sections including the Background which provides the historical background, vision and mission of the University of Malawi; Literature review covering relevant literature on factors that affect gender equality and equity relations within and outside the academia in the Malawian context. Methodology covers data collection methods and analysis followed by Results and Discussion and lastly Conclusion and Recommendations.

1.1 A brief overview of Chancellor College

The University of Malawi Act No. 12 of 1998 provides a legal framework for the operations of the University as well as for the provision of university education. The Act defines the functions of the University as follows (a) to encourage the advancement and dissemination of learning and research; (b) to engage in such university education and research as is responsive to the needs of Malawi and the whole world; (c) to provide facilities for higher education, for research and for the advancement of knowledge in such branches of learning and study and for such persons, whether members of the University or not, as the Council may from time to time determine; (d) to award and confer Degrees and Diplomas, and other academic distinctions, including Honorary Degrees and distinctions. As a constituent college of the University of Malawi, Chancellor College operates within the context of the University of Malawi Act, and its functions as defined under the Act are teaching and learning, conducting research and carrying out outreach and community engagement activities. Other constituent colleges of the University of Malawi are Kamuzu College of Nursing, College of Medicine and The Polytechnic.

Chancellor College is the largest constituent college of the University of Malawi. The College has 224 members of academic and administrative staff who are in established posts. There are five support units for the college and these are Finance, ICT Centre, the Library and Procurement and Publications Unit. The number of students has not increased much over the years: there were about a 1,000 students in 1990 and currently the total enrolment is just below 5,000 students. The College has 25 academic departments housed in five faculties namely Humanities, Science, Law, Social Science and Education. Postgraduate programs are coordinated by the Dean of Research and Postgraduate Studies.

In addition to academic departments, Chancellor College also has four vibrant research centres housed in specific faculties. The Centre for Social Research (CSR), housed in the Faculty of Social Science, is a multidisciplinary research centre which has been in existence since 1979. Faculty of Education has the Centre for Educational Research and Training (CERT) which is specialized in conducting research in education and education related fields whereas the Centre for Language Studies (CLS) in faculty of Humanities conducts research and consultancies in Malawian languages. The Natural Resources and Environment Centre (NAREC), housed in the Faculty of Science, provides infrastructure for research, training, consultancy and outreach in natural resources and environment.

2.0 Literature Review

This section reviews various reports on studies related to gender climate in higher education. It outlines the history of women employment in higher education as well as highlighting constraints and opportunities that inhibit gender equality in the sector.

2.1 A brief history of the employment of Women lecturers in Tertiary institutions

In the 19th century, women's desire for access to education and opportunities for employment in science and other sectors were greatly accelerated by the advent of the women's colleges, as is well documented in the encyclopedic historical work of Rossiter, (1982[5], 1995[6]). These schools prospered and women graduates were often hired as teachers of the next generation. However all women in the college faculties had to be single; if they decided to marry, they had to resign, a practice that in some parts of the Western world continued well into the 20th century. This was coupled with the belief that women could not handle both professional and family responsibilities[7]. In addition, the women's colleges had very heavy teaching loads, precluding faculty from doing publishable research.[8]Nevertheless, these were the best jobs women could aspire.

Barnett[9] posits that the employment situation for women lecturers especially in science took a turn for the worse as the women's colleges began to focus on improving their prestige. One important step was to require Ph.D. degrees, another was to recruit male faculty. In order to attract males they had to offer strong incentives, including no restriction on marriage, indeed, young married men with families were preferred candidates. The men were also offered reduced teaching loads, higher salaries, college-funded support for their research, and allowances for family expenses. This two-tier hiring system produced several negative consequences for women faculty. First, few women at the time had doctorate degrees because, at the time, most European and U.S. universities refused to allow women to matriculate into their graduate schools. Second, male faculty began publishing research, whereas women faculty, still burdened by lack of support and heavy teaching schedules, did not. Finally, women's colleges ceased to be the primary employer for women; their mission became to educate women, not hire them.

It is also reported that a woman academician married to a male academician would not be hired by the same department and was often refused employment at the same college or university. This resulted into many highly educated married women not finding employment, especially in small cities and towns with only one academic institution[10]. But was this a European-American phenomenon only? Were African universities any better than this?
These questions have been so difficult to answer due to limited literature; however the available little literature indicates that women in African universities were also heavily underrepresented. Only a few women became university lecturers and the gender gap was huge.[11] In sub Saharan Africa a key historical factor linked to gender inequality in higher education was the colonial legacy.[12]Colonial authorities promoted a few elite men in higher education, both whites and non whites, whereas many people, especially women, were without opportunities.
Having looked at this brief history of women employment in universities, the question that remains unanswered is whether the underrepresentation of women in tertiary institutions is still an issue today as it was decades ago.

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[5]Rossiter, M.W. (1982)Women Scientists in America: Struggles and Strategies to 1940. Baltimore, MD: John Hopkins University Press, 1982.
[6]Rossiter, M.W (1995). Women Scientists in America: Before Affirmative Action 1940-1972. Baltimore, MD: John Hopkins University Press, 1995.
[7]Barnett, R.C.,(2009) *AShort History of Women in Science: From Stone Walls to Invisible Walls* Brandeis University. Women's Studies Research Center. Retrieved from www.brandeis.edu/barnett/docs/7654.PDF
[8] Ibid
[9] Ibid
[10] Ibid
[11]Mangheni, N.M., &Ekirikubinza- Tibatemwa,L., (2010). *Gender issues in agricultural education within African universities.* Gender Background Paper presented at Ministerial Conference on Higher Education in Agriculture in Africa. Retrieved from
www.ruforum.org/.../**Gender**%20Background%20%20%20paper.pdf
[12] Ibid

2.2 Gender issues in African universities

A number of studies have provided almost unanimous answers to this question. Indeed juxtaposing the answers one observes little or no variations with regard to the contemporary situation in African universities. Mangheni and Ekirikubinza- Tibatemwa[13] examined the concept of teaching and gender in tertiary institutions in Africa and reported that the legacy of inequality entrenched during the colonial period persists today. This was further corroborated by AAU (2006)[14] who reported that in many African institutions of higher learning gender issues are regarded with fear and trepidation. There is demonization of gender activists and dismissal of gender issues as western, donor inspired and un-African. AAU (2006)[15] further posits that these attitudes often mask ignorance about gender issues and fear of exposure of this ignorance. In addition, gender biases which exist in the wider society are internalized and acted in higher education contexts. This has often resulted in low numbers (e.g. 7% on average) of women teachers in African tertiary institutions[16]. According to AAU (2006)[17], women continue to be ghettoized in clerical and secretarial positions at the lowest ends of non academic hierarchy and in junior untenured part time and temporary academic positions.

According to Mangheni[18] women constitute a small minority of the staff in agricultural faculties in African universities especially in higher positions compared to men. Although the emphasis was on agricultural faculties, literature is awash with evidence that women are heavily underrepresented in all faculties in African universities. For example UNESCO (1998a: 2) cited in Endeley, et al (2008)[19] reported that although there are no formal obstacles preventing women from reaching high positions in colleges and universities, men still dominate at all levels of influence. Career progression for women is much slower than that of men. Studies have reported that the proportion of women academic staff in agriculture faculties for example is as low as between 6.1% to 20%.[20] Women also tend to hold more junior positions. With the exception of a few universities, the vast majority have one or no woman professor.

Although there is limited literature on teaching and gender in the tertiary institutions especially in the University of Malawi, the 2013 staff list of UNIMA indicated that there were more male lecturers compared to women lecturers. These findings agree with AAU (2006)[21] and Mangheni[22]who observed that women in African tertiary institutions are heavily underrepresented from the

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[13] Ibid

[14] AAU (2006) *A ToolKit for Mainstreaming Gender In High Education in Africa*. Retrieved from http//www.aau.org

[15] Ibid

[16] Ibid

[17] Ibid

[18] Mangheni, N.M., &Ekirikubinza- Tibatemwa,L., (2010). *Gender issues in agricultural education within African universities.* Gender Background Paper presented at Ministerial Conference on Higher Education in Agriculture in Africa. Retrieved from www.ruforum.org/.../**Gender**%20Background%20%20%20paper.pdf

[19] Endeley, J.B.M &Ngaling, M.N (2008) *Challenging gender inequality in higher education: Attitudes and perceptions of teaching staff and administrators at the University of Buea, Cameroon.* Retrieved from http//www.ahero.uwc.ac.za/index.php?module=cshe&action=viewtitle&id.

[20] Mangheni, N.M., &Ekirikubinza- Tibatemwa,L., (2010). Gender issues in agricultural education within African universities. Gender Background Paper presented at Ministerial Conference on Higher Education in Agriculture in Africa. Retrieved from www.ruforum.org/.../Gender%20Background%20%20%20paper.pdf

[21] AAU (2006) A ToolKit for Mainstreaming Gender In High Education in Africa. Retrieved from http//www.aau.org

[22] Mangheni, N.M., &Ekirikubinza- Tibatemwa,L., (2010). Gender issues in agricultural education within African universities. Gender Background Paper presented at Ministerial Conference on Higher Education in Agriculture in Africa. Retrieved from www.ruforum.org/.../Gender%20Background%20%20%20paper.pdf

academic ranks to the administrative positions. A study conducted by Endeley[23] in the University of Buea, Cameroon also observed that men dominate at all ranks, particularly that of professor. It can therefore be argued that just like other African universities, UNIMA experiences a classic disparity by gender in terms of teaching staff.

2.3 Women experiences in academia

Reports also indicate that despite there being no formal obstacles preventing women from reaching high positions in colleges and universities, men still dominate at all levels of influence. The usual channel for rising through the academic ranks is dependent on academic or professional credentials. The common criteria for promotion are academic qualifications (a tenure track promotion is automatic upon obtaining a higher degree), academic merit (assessed by the number of publications), research, and supervision of graduate students, contribution at seminars / conferences, workshops and quality of teaching. However despite the absence of formal discrimination of women in career progression, institutional factors as well as external factors limit their progression. The external factors such as marriage, domestic responsibilities and culture limit academic women's participation in research, culminating into fewer publications which contribute heavily on points for promotion. Another issue is that in most universities like UNIMA, there are few women in leadership positions with one study reporting only 17% of the management positions in faculties of Agriculture for instance, occupied by women compared to 83% by men (RUFORUM, 2010) cited in Mangheni.[24]

Excelling in academics is much harder or challenging for women than men. Women enter doctoral studies in order to increase their career flexibility, seek out new challenges and build their skills. These career outcomes are often too difficult to realize. Even though academic mentorship is a key to progressing up the academic ladder, support is often lacking for women e.g. there are few women doctors/ PhD holders in universities to offer a mentoring relationship to female doctoral candidates (Byoko). Some female academics also find some sort of resistance from their counterparts, their opinions, for example might not be taken into account or simply not heard, this is when comparing treatments once they become members of staff. They might find themselves getting interrupted more than their male counterparts (Byko). Another factor is that women tend to have multiple roles regardless of whether one is an academic or not. Balancing the roles can hence be a challenge in academic circles.

Some of the factors that explain this gap include the lack of women with relevant qualifications especially in fields that have historically been dominated by men. Furthermore reluctance by some qualified women to take up administrative responsibility due to the challenges of balancing career and care giving responsibilities has also been viewed as one of the impediments on women career progression.[25] It can be said that tertiary institution has not been a hospitable employer for women. It is therefore not very unusual to see that most women employed full time in academia are less likely than men to be tenured and, on average, earn less than their men counterparts.[26]Furthermore, women are less likely than men to be employed at the highest tiered academic institutions. Some authors have reported a greater vulnerability of women due to experiences and consequences of stress at work in a university setting. Women in higher education more often report work/home

[23]Endeley, J.B.M &Ngaling, M.N (2008) Challenging gender inequality in higher education: Attitudes and perceptions of teaching staff and administrators at the University ofBuea, Cameroon. Retrieved from http//www.ahero.uwc.ac.za/index.php?module=cshe&action=viewtitle&id.

[24]Mangheni, N.M., &Ekirikubinza- Tibatemwa,L., (2010). Gender issues in agricultural education within African universities. Gender Background Paper presented at Ministerial Conference on Higher Education in Agriculture in Africa. Retrieved from www.ruforum.org/.../Gender%20Background%20%20%20paper.pdf

[25] Ibid

[26] Ibid

imbalance as an important source of stress and experience more intense and increased pressure to publish scientific papers.[27] This means that women employed in institutions of higher education experience higher levels of both work and family stress than men. As a consequence, some women have more often considered leaving the job due to stress (Bradley[28] and O'Laughlin[29]).

2.4 The role of the family and community in the promotion of gender equality

It has been reported that the low numbers of qualified academic female members of staff might be a reflection of the culture of low female enrollment in tertiary education. Hyde (1989) reported on the findings from a study that sought to identify factors, summarize strategies and suggest policies that could improve female education in sub-Saharan Africa. The study considered the importance of family, school and community factors as well as education policies in increasing the participation of girls and women in school and improving their achievement levels. It was reported that since 1980, countries with both low and high levels of enrolment (of females) showed evidence of both relatively equitable and inequitable female participation. Hyde (1989) further explained that background characteristics such as socio-economic status, parental level of education, region of residence and religion appeared to be more important for girls than boys. In another report, Hyde (1993) it was reported that there was a difference in parents' desire for education whereby sons were favoured over daughters. The report also stated that educational expenditure of parents on daughters was low compared to that of boys even though educated parents were more willing to spend more on their daughters than low level educated parents.

Closer to home, Chirwa (1994) reported that in society, it was viewed more beneficial to educate boys than girls as they would grow up, get married and be taken care of by their husbands. The report further argued that equal status for all did not make sense unless it was accompanied by efforts to equip the women with the ability to fend for themselves. Education was emphasized as the key factor to uplifting women's lives and status. Chirwa (1994) further proposed that girls in higher education needed to be encouraged to choose non-traditional subjects such as science and not be stuck in professions that are deemed "proper" by society.

There have been other suggestions for improving female education and the proposed strategies include increasing school spaces through more flexible and efficient use of school resources, raising the number of female teachers, addressing teacher attitudes and widening curriculum options for girls. In addition, elimination of administrative and fiscal policies that negatively affected the opportunities for female schooling and or employment were also recommended.

2.5 Affirmative action for females in higher education institutions in Malawi

Generally, tertiary education in Malawi admits a much smaller cohort of the eligible school population with fewer females enrolled at this level than at lower levels of the education hierarchy (Kadzamira, 1995). Hence, the university adopted a preferential admission policy for women with them being admitted into the university with slightly lower aggregate scores than males to increase proportion of females. Once enrolled, it was observed that there were gender differences in courses pursued by students with the majority of the female students concentrated in nursing, humanities and education with only a small proportion of them enrolled in nontraditional areas. This was due to

[27]Kinman G, Jones F. (2008) A life beyond work? Job demands, worklife balance, and wellbeing in UK academics. J Hum BehavSocEnvir. 17(1-2):41-60. Retrieved from www.tandfonline.com/doi/pdf/10.1080/10911350802165478

[28]Bradley J, (1995). Occupational stress within a U.K. higher education institution.Int J Stress Manage1995;2:14558. Retrieved from http//www.link.springer.com/article/10.1007%2FB01740300

[29]O'Laughlin EM, Bischoff LG. Balancing parenthood and academia. Work/family stress as influenced by gender and tenure status. J Fam Issues 2005;26:79-106. Retrieved from http://in.bgu.ac.il/womenforum/DocLib/articles/BalancingParenthoodandAcademiaworkamilystressasin.pdf

the fact that for a long period from the 70's up to the late 80's women in UNIMA were not encouraged to study law and engineering. Instead, women were encouraged to study humanities, arts, social sciences and education. This was due to the perception that girls cannot do as good as the boys in school. Thus, Malawi Government put up deliberate measures to encourage girls to study non-traditional subjects such as engineering for example setting quotas for entrance into secondary and tertiary levels of education, the provision of scholarships for girls to study nontraditional subjects at tertiary level and removal of restrictions on the subjects females can study at the secondary and tertiary level.

2.4 Education policy framework and gender in Malawi

There have been efforts at national level to promote the engendering of education policies. The Ministry of Education, Science and Technology's Policy and Investment Framework (PIF) for the period from 2000 to 2015 and the Malawi Poverty Reduction Strategic paper (MPRSP) clearly states that high priority would be given to the gender imbalance and inequity in the education system at all levels (Maluwa-Banda, 2003/04). One of the goals stated in PIF is to improve the participation of girls in science. Both PIF and MPRSP recognize the need for gender sensitivity in education through appropriate educational policies and practices. Gender focused initiatives outlined in PIF and MPRSP are directly more pronounced and visible in the policy related areas of educational access, equity and relevance of the curriculum at all levels of the education system. However, the report also outlines the main challenges in the implementation stage of such gender sensitive policies into practice in schools. The report noted that the tertiary level has been the slowest in responding to gender imbalance and inequality.

The National Education Sector Plan (GoM, 2008) sets out the government's view of Malawi's education sector goals, objectives and how such goals and objectives will be realized over the coming decade (2008-2017). One of the goals is to expand equitable access to education to girls, people with special needs and other disadvantaged youths and those from rural communities at all levels of the education system. There is also the intention to increase female participation to at least 50% of the total national school enrollment at all levels of education. Even in vocational and technical training, the trend has been to increase enrollment which is biased towards increasing the intake of females and students with special needs in non-traditional areas.

In University of Malawi, the gender gap is more pronounced both in student enrolment and teaching staff enrolment. Although enrolment into the university has been increasing in general, the admission of female students somehow remained more or less the same over the years. . As of 2010, 30% of the 4500 student population was female. Roles in Malawi are characteristically gender determined with women being given the nurturing role. Expectations and behavioral norms begin at home and in the community and are reinforced in the school setting limiting girls to domesticity and boys to produce careers. Girls are expected to be shy and submissive and career goals are limited to teacher, nurse, doctor or secretary while boys have a wide range of choices.

2.5 Sexual division of labour

2.5.1 Sexual division of Labor in Malawi

The tradition that women are home keepers and men are bread winners still persists in many areas in Malawi. It is perceived that a woman's place is the kitchen whilst a man should go out of the home to work so as to provide for the family. This traditional gendered division of labour remains a challenge in Malawi and does not only exist at family level but also manifests itself in the employment arena. That there is gendered division of labor in work places is not contentious. This division can be clearly appreciated when one divides employment into formal and informal. Formal

employment includes professional and technical jobs such as those of doctors, lawyers and administrators. Agriculture and other law skilled work make up the informal employment.

It is on record that the formal employment is mostly dominated by men while informal is mostly dominated by women. By 1998 for example, only 44716 women were in profession and technical areas of employment while men constituted 79708. On the other hand in Agriculture, animal and forestry, women constituted 20,747,758 while men constituted only 1,645,503 Women thus constitute only about 19% of the formal employment. The rest is dominated by men[30]. In this informal employment, there is also gendered division as regards to positions which men and women occupy and the wage earnings which they receive. Most women occupy lower positions with low wage earnings as compared to men. These women are also paid less as compared to men. The lower pay is even true for the same type of job and number of hours. However, remuneration of both men and women is similar at levels where education level or training is key entry requirement[31].

2.5.3 Sexual division of labor in UNIMA with reference to CHANCO as an example

Chancellor College has about 430 staff members, including academic, administrative and supporting staff. Among these, only about 130 staff members are female[32], and the rest are males. Already, it is clear that the college is dominated by male staff members. As if this is not enough, there is still gender divisions as regards to the positions which female staff hold in the college with reference to those held by their male counterpart. Female staff dominates in lower positions with low earnings while male staff dominates in higher positions with greater earnings. For example, almost all secretaries at CHANCO are women, and they are about 43 Secretarial positions are very lower positions, and even the pay itself is lower as compared to that of other positions such as lab assistant and many others of that nature. Even when one examines positions among the administrative staff, the likelihood is to find that higher positions such as that of Principal, Registrar and Senior Executive Officers are dominated by male staff, with only 2 females- one as assistant registrar, and the other as Senior Executive Officer for Human Resource. Note should be taken however, that the administrative section has 4 secretaries, all of which are females. All this explains the existence of sexual division of labour at Chancellor College and in UNIMA at large. Furthermore, each faculty is headed by a Dean, who has a deputy giving a total of ten. However, only two are female and both are deputies. This implies that female members of staff within the College do not hold positions of greater economic value as such positions are dominated by men.

3.0 Research methodology

Both qualitative and quantitative methods were used to gather data on gender climate at Chancellor College.

3.1 Policy document analysis

This involved a gender analysis of the conditions of services of both academic and non academic staff documents to assess whether they are inclined to favour one sex over the other. This involved the critical examination of the documents to assess to whether there are obstacles for staff professional progression or explicit opportunities exist for staff motivation. A gender checklist was used to assess the relevant employment documents. Furthermore, desktop research also reviewed policies on employment law, women education in Malawi and beyond, conditions of service and gender; teaching and gender in tertiary institutions and comparable policies or conditions of service and gender from other Universities. Literature analysis was also conducted to assess if there was correlation between work policies and implementation and if this was reflected in how both

[30]Kanyongolo, N, R. et al. SADC gender Protocol Baseline Study: Malawi country Report Draft July 2009.
[31]Liwewe O, M. and et al. Gender and human Development in Malawi, March 2009
[32] The Chancellor College internal Directory-January 2013

academic and non academic staff perceived gender issues. In addition, there was also a review of past gender surveys and statistics on gender at Chancellor College.

3.2 Interviews

The team adapted the research guide from MSU to develop the questionnaire which was used for individual interviews as well as for focus group discussions. A number of interviews were conducted with senior management personnel in college administration, academic and non-academic members of staff. Parameters that were investigated included entry requirements for the position, terms and conditions of service, salary and promotions, professional development, leave (maternity, sick leave, compassionate, annual), the actual office/ working environment and resources/support for the job. These interviews were conducted via email and in person. Consent was obtained before interviews and respondents were assured of confidentiality and anonymity. Questionnaires were administered to a total of 58 respondents (27 academic and 31 administrative and support staff). Focus groups discussions were conducted with the following respondents: female Clerical & Technical Staff; male Clerical & Technical Staff; mixed male and female Clerical & Technical Staff; female academics, male academics, mixed male and female academics as well as mixed male and female administrators.

3.3 Data analysis

Data collected was analyzed using quantitative and qualitative means as elaborated below.

3.3.1 The Quantitative Data Analysis

Data was entered in CSpro. CSpro is a robust statistical package that is essential for data cleaning. CSpro does not permit entry of data that is not defined unlike SPSS which allows anything to be entered. Having entered the data in CSpro, it was exported to SPSS where relevant analyses were carried out to generate frequencies regarding responses to questions answered by participants.

3.3.2 Qualitative Data approach

A thematic approach was used where by the data was analyzed in terms of emerging themes. This involved reading and re-reading transcribed data. Issues emanated from the qualitative data complimented insights from quantitative data.

4.0 Results and Discussion

This section presents a discussion of the results of the study. The study sought to assess a gender climate scenario at Chancellor College in terms of employment, professional development and career progression opportunities. The results of the investigation are presented as below.

4.1 Gender considerations and staff recruitment

Of concern to the study was whether there are gender consideration when recruiting staff both in the academic and support staff categories. Fig 4.1 shows how participants responded the question.

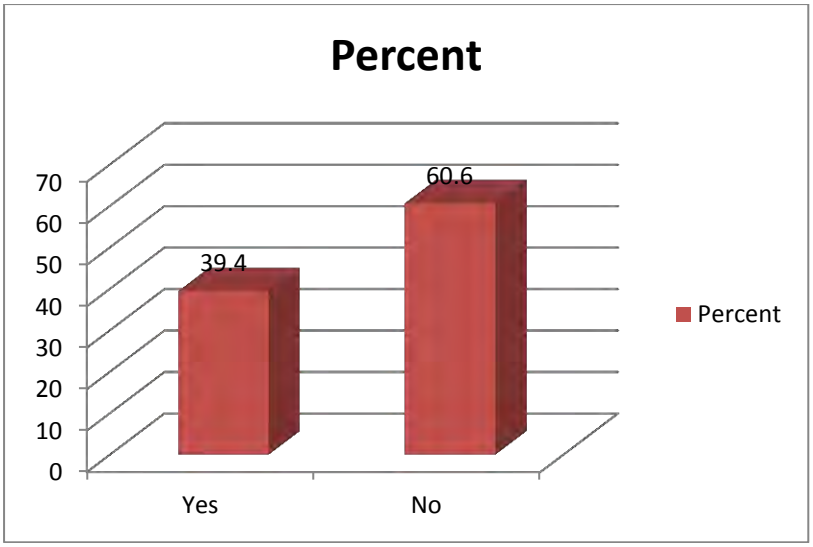

Figure 6 Are there gender considerations when recruiting staff?

As shown in Fig 4.1, 60.6 percent of the respondents felt that recruitment at Chancellor College does not take into account gender consideration. However, 39.4 percent of the respondent felt otherwise. It is interesting to note that statistics do not change when asked whether there was consideration of gender in their respective departments as depicted in Fig 4.2 below.

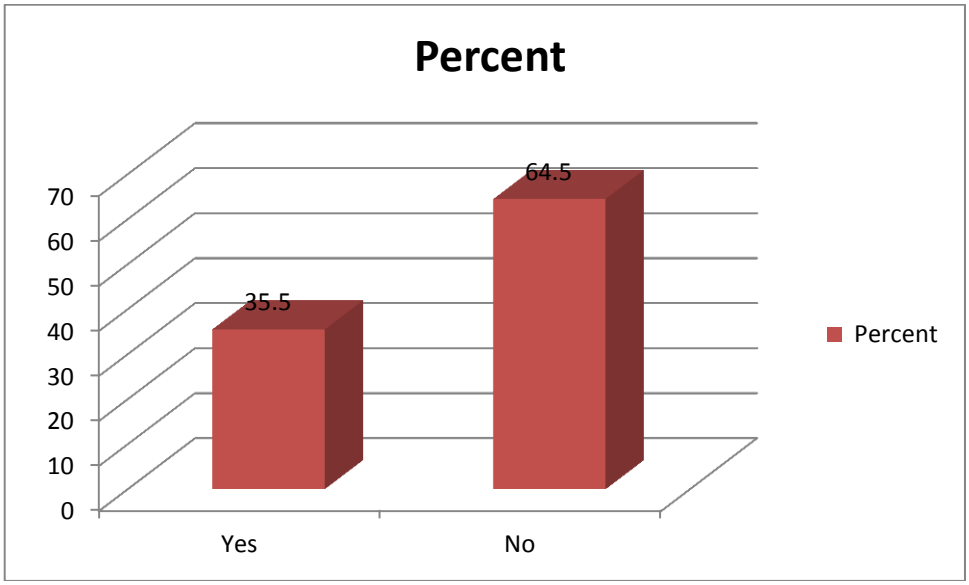

Figure 7 Are there gender considerations when recruit staff in your department?

Respondents who indicated that gender considerations were taken into account reported that this was motivated by the following factors;

- A standing departmental position that every time there is a position to filled, women are also considered.
- Nature of the department "our department deliberately recruited two females since it deals with issues about gender"
- Affirmative action: "to get more female members of staff in order to motivate female students.

However, one respondent observed that recruitment was being done with reservations as it was perceived that women are more likely to leave following husbands if not resident in Zomba. The fact that we have some participants responding affirmatively and others negatively show that there is clear gender policy framework that guides the recruitment of staff. Respondents were also asked as to whether they favoured gender balance during recruitment and 62.9% of the respondents responded positively whilst 37.1% did not favour gender considerations.

The study found that there is no standing policy within the University of Malawi that favours or disadvantages one sex over the over in terms of staff recruitment. However, traditional practices showed that some careers in the non-academic sector such as secretaries were largely the preserve of females. As one respondent observed:

> It appears that such secretarial jobs are fit for women and messenger post are fit for men

This is in consonant with the prevailing role stereotype that secretarial duties are women occupations. Analysis of the employment levels at Chancellor College revealed that posts of messengers were dominated by male staff.

One respondent emphasized the fact that certain positions within the college needed to be filled by male staff;

> ..Yes there are some posts that women have problems in delivering. For example working in the bindery and the records office. It has been shown that even women themselves shun such jobs…

There was divergence in views between academic and non academic members of staff on whether there should be gender considerations when recruiting staff into the university. The majority of non-academic staff suggested that the college should take into account gender when recruiting staff on the other hand most academic staff expressed the view that merit should be the only criteria for staff recruitment as it was pointed out:

> No... simply use merit, otherwise you may end up recruiting people who are not qualified all in the name of trying to strike some gender balance

4.2 Terms and Conditions of the service

Majority of respondents perceived that terms of conditions were not discriminatory. The general impression was that staff do not look at the conditions of service using gender lens. However, it was reported that when it comes to education benefits for members of staff, a couple employed by UNIMA is treated as a unit instead of taking each as employed in his or her right. This was perceived as an unfair practice.

4.3 Salary and promotions

The study sought to find out if salaries and promotions were affected by one's gender. Fig 4.3 shows participants' responses to the question whether salaries were affected by one's gender.

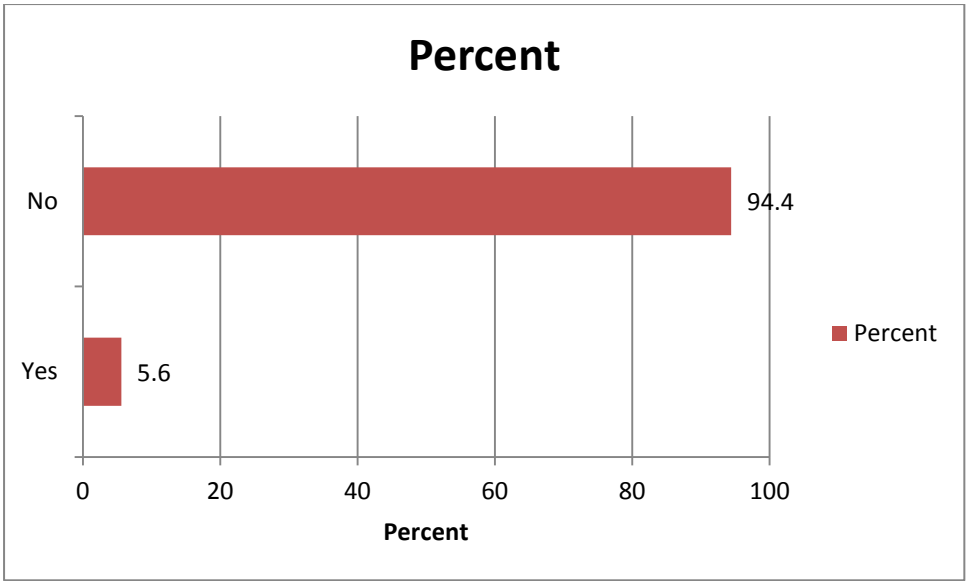

Figure 8 Is your salary influenced by your sex?

Nearly all respondents (94.5%) reported that gender did not affect the salary that one received at the end of the month. The minority who felt that gender was a factor cited length of service and education level which had nothing to do with gender. This trend of perception was also reflected with regards to promotions whereby 86.1% reported that promotion was not gender related whilst 13.9% reported otherwise (Fig 4.4).

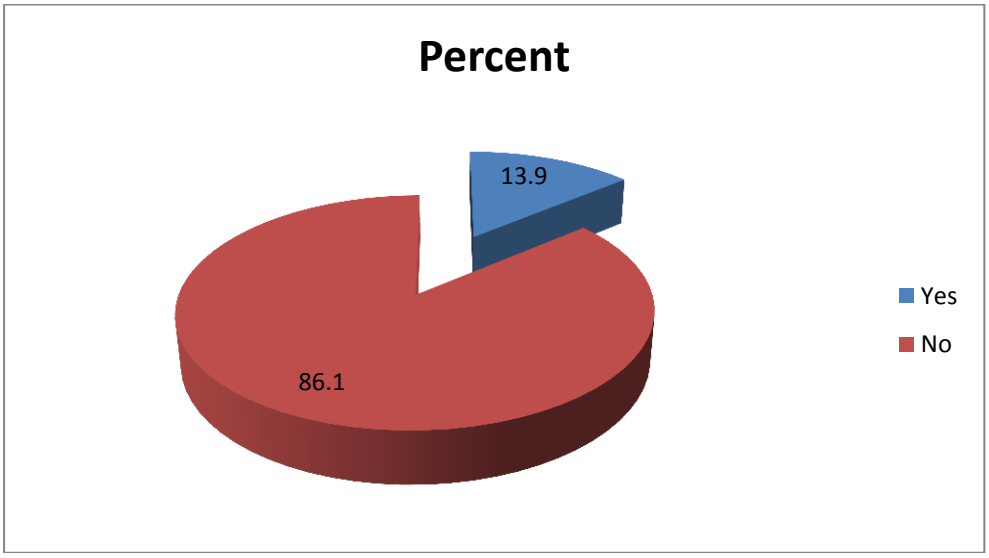

Figure 9 Is promotion influence by one's sex?

The perception was common to both male and female staff. Academics observed that

> "Depends on what you have done. i.e... Published articles and other academic interactive etc. it also depends on the length of service as well"

Interestingly, one female academic observed that:

> "However they should consider that women have families to take care of and societal duties. This is usually overlooked and women are passed over"

This recognizes the fact that females are affected by both academic and external factors. In contrast, CTS participants reported that promotions were influence by gender. One participant observed that:

> Promotion by virtue of being female and also their closeness with bosses seems to work to their advantage. A woman can reach the last level of promotion whilst a man struggles to get there, even if they initially started work at the same time and have the same qualifications.

This was not an isolated observation because most of male non-academic members of staff expressed the view that promotional prospects for female staff were higher compared to their male counterparts. One respondent observed that;

> Yes, especially secretaries, they get more chances of promotion by virtue of being female. And their closeness to their bosses seems to work to their advantage. A woman can reach the last level of promotion while a man struggles even if they initially started work at the same time...

Overall, the study found that salaries are not influenced by gender. Male and female staff holding the positions falls with the same salary scale. Most members interviewed were cognizant that salaries in the University of Malawi are not affected by gender. However, it was perceived by some respondents that the promotion criteria for non-academic members of staff was less rigorous and subjective hence creating room for biasness.

4.4 Professional development

The study found that within the university there three ways in which staff achieved professional development; self initiatives, department support and , full scholarship. Some members reported that contrary to their initial expectations, they personally applied and secured scholarship for their studies and all the college did was to release them for the study period. Some departments offered postgraduate programme from which members benefited. In the case of staff securing partial scholarship, department helped to foot other costs. The last mode of profession development was one whereby full scholarships were sourced by the university office and offered to eligible staff. The study found marked difference in the path to professional development between academics and CTS . Most CTS reported that educational or staff development initiatives are largely in favour of academic members of staff. One participant complained that:

> The main emphasis on professional development is on academic members since they perform the core functions of the University of Malawi

Some junior academic members observed that they were not supported professionally:

> It has been hard for me to professionally develop for lack of mentorship in terms of publishing

Some observed that institutional initiatives hardly exist. Staff upgrade professionally through self initiatives. In the case of non-academic staff, most CTS reported that they had undergone certificate, diploma and workshops. Respondents reported professional development is not influenced by gender.

4.5 Leave maternity leave

Most female staff reported that they enjoy maternity leave. The present conditions of service do not explicitly state that male staff can get paternity leave but a few members have enjoyed paternity leave through individual initiative.

4.6 Compassionate leave

The conditions of service of the University of Malawi grant compassionate leave to staff owing to illness and other unfortunate eventualities. Respondent reported that they were not aware of compassionate leave. However, they were often allowed to attend to some family responsibilities and obligations on humanitarian grounds. Heads of department allowed staff to go on such leave without necessarily asking the staff concerned to fill in compassionate leave forms. Thus while compassionate leave is formal arrangement within the conditions of service, it is granted informally.

4.7 The office / working environment

The study sought to find out whether the office environment was conducive to members of staff and results are given in Figure 5.

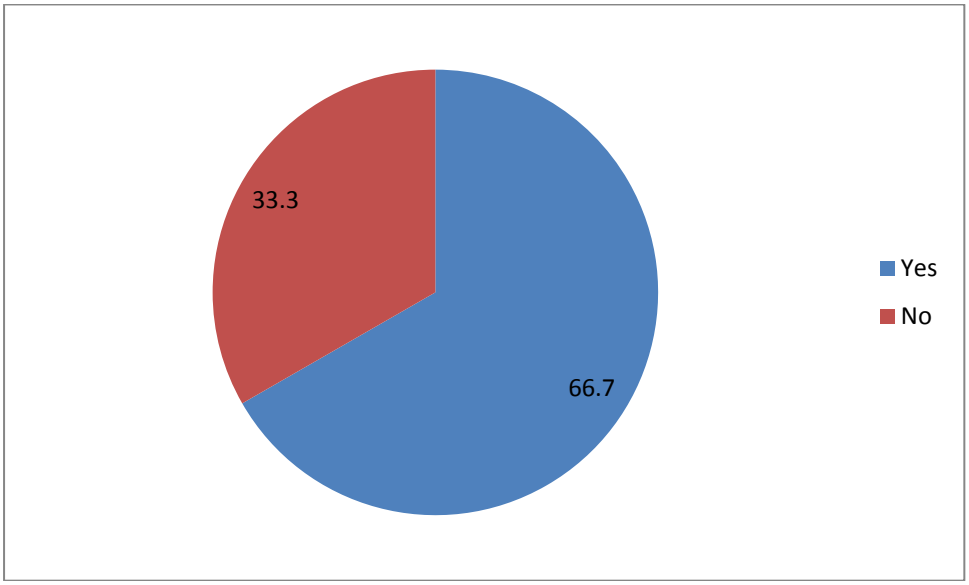

Figure 10 Is the office environment conducive for you as a female/male lecturer?

Majority of participants (66.7%) reported that the office environment was suitable. However 33.3% of the participants felt that office environment was not ideal. One participant complained that:

> there is no space as I have no personal office i.e. I use a departmental library as an office whilst another female respondent reported that the work desk is not female friendly.

Despite most respondents reporting the working environment as being ideal for their work, members were concerned with the quality of their offices. One member of staff complained:

> **"**The offices are generally not good enough. They can best be described as cubicles which are often shared by a minimum of two people. The sharing makes it even impossible to concentrate on work. The offices are often too hot during summer, and too cold during cold weather"

4.8 Sexual harassment

Figure 6 gives the findings in relation to sexual harassment.

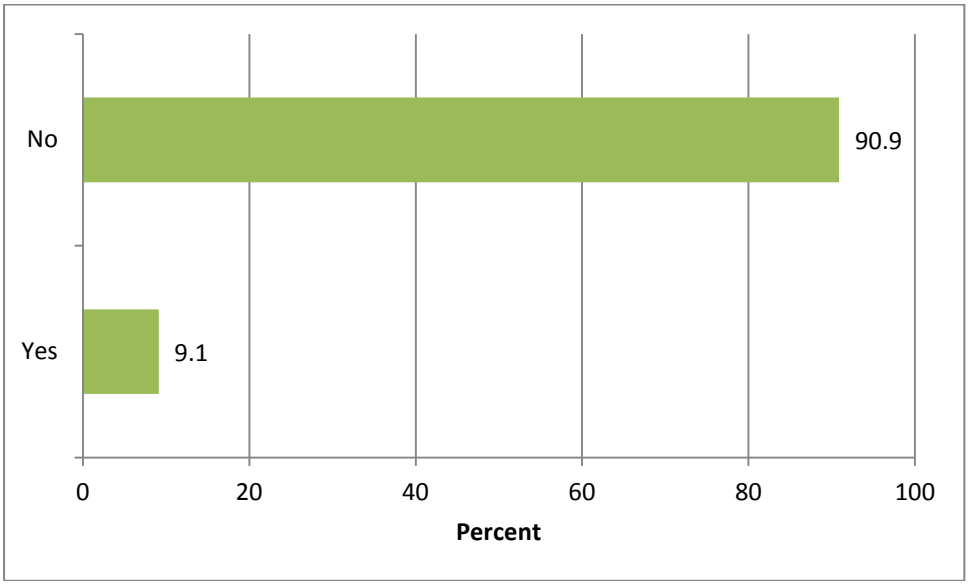

Figure 11 :Have you ever experienced sexual harassment?

Ninety one percent of the female respondents reported that they had not experienced sexual harassment whilst 9.1 % reported sexual harassment. However, these figures should be taken cautiously as many people do not wish to report such matters as they are considered to be very personal and sensitive. Indeed, those that reported sexual harassment did not report the issue to authorities because in cases where it was reported, no disciplinary action had been taken against the male colleagues.

4.8 Resources and support

Most of the lecturers interviewed reported that resource support was limited. One lecturer observed that;

> "The availability of resources is a big problem to all lecturers. While there may be gender-specific resource constraints, gender may not be the primary reason for the resources unavailability"

Another lecturer observed that;

> **"**No. I don't think there is any deliberate effort from university authorities to mobilize teaching resources for lecturers whether male or female".
> Yet another respondent asked ' there are no conference and research funds available, how do they expect us to grow?'

It is evident from the above quotations that departments with the support of college management need to ensure that teaching and learning resources are well catered for. In general, limited financial resources affect the amount and quality of resources and support that a college can render to its staff.

5.0 **Conclusion and Recommendations**

The study has shown that gender differences exist in some areas within Chancellor College even though these are not many. On the basis of the above discussion, following are some salient recommendation that could promote gender equity within the university of Malawi.

5.1 Recruitment

The employment statistics clearly reveal that Chancellor College is a male dominated institution in terms recruitment. We recommend that deliberate policies to ensure a more gender balanced recruitment both in academic and non-academic positions.

5.2 Promotions

While promotion criteria for academic staff appear to be rigorous and objectives in promoting staff (both female and female staff are subjected to the same criteria), there is need for more consultation for future changes. It is also recommended that the promotional criteria for members of non-academic be reviewed to ensure the formulation of more objective criteria.

5.3 Professional development

The study found that policies on professional development were neither efficient nor adhered. It is critical that annual budgets line for professional development for members of staff should reflect the strategic development plans of respective departments.

5.4 Working environment

College management needs to make deliberate efforts to increase office space for members of staff.

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Appendix H: HED Process Evaluation Executive Summary

Partnership Process Evaluation conducted in April, 2014

Higher education partnerships are frequently challenged by the dynamic nature of the context in which partners are working. Consequently achieving results, depends on partners' successful collaboration in establishing and maintaining management systems and processes that are responsive to contextual changes and flexible enough to allow for timely adjustments to implementation plans.

This report presents the results of a pilot study that HED conducted to inform its process evaluation framework and understand whether tools based on this framework can more clearly articulate successful elements of mutually beneficial, capacity building, higher education partnerships. Individuals afilliated with a partnership among Michigan State University (MSU), Lilongwe University of Agriculture and Natural Resources (LUANAR), Chancellor College, and the Lincoln University (LU) contributed to the pilot study process by providing feedback and input into the process evaluation framework development and by serving as the subject of this study. This pilot was designed as an interactive and participatory exercise oriented towards enhancing both accountability and learning, for both HED and the partners. HED gratefully acknowledges the willingness of Michigan State University, UNIMA and LUANAR to provide critical and informative feedback and engage in honest dialogue to promote learning about the management and evaluation of higher education partnerships.

The partnership, entitled *Agro Ecosystems Services: Linking Science to Action in Malawi and the Region,* was established to enhance the capacities of LUANAR and Chancellor College in the area of Agro-Ecosystem Services (AgESS), enabling these institutions to enhance faculty development and respond to research, curricula, and outreach needs identified by government, the colleges, private sector, and non-governmental organizations (NGOs). Areas of study on which the partnership focuses include sustainable land and water management, and irrigation, watershed and forestry management; soil fertility and conservation agriculture; agricultural and natural resource governance structures, strengthened policy dialogue; management of the agro-ecosystems dimensions of climate change; and enhanced agricultural research capacities.

This pilot process evaluation examined program management systems and processes of the partnership by studying and conducting a critical path analysis of one program element- a series of short courses for faculty development known as AgESS. In a series of structured interviews, HED staff met with partnership management, course participants, and other relevant stakeholders. The HED team found that the AgESS short courses were implemented in an economic and efficient manner. The approach to short course planning, curriculum development and course facilitation was highly participatory, creating an environment for good collaboration among implementing institutions and course participants. The short course preparation process was managed well and the content was relevant. Evaluation results show that there was consistent and positive engagement of stakeholders from the planning grant stage through the delivery of the AgESS short courses and even beyond. Participant engagement contributed to the relevance and smooth running of the AgESS short courses.

HED found strong partner commitment to financial transparency and equality in decision-making. One of the challenges for partners was created by their relationship to HED. HED partnership award agreements make the US higher education partner, in this case MSU, the legally responsible party for fiscal and reporting compliance. In order to remedy this challenge and maintain their commitment to financial transparency and equality, MSU and the Malawian partners developed a clear and consistent financial management process, which hinged on open and transparent sharing

of financial data and financial decision-making processes. MSU's institutional policy of equal remuneration for US and host country faculty was seen as one key contributor to equality and to establishing trust among the partners.

Another challenge that partners all shared concern about was their perception that the management and compliance demands of the USAID local Mission, USAID in Washington (E3 Bureau and Africa Bureau) and HED seemed to change and expand throughout the period of planning and implementation. In the implementation phase, the guidance from USAID and HED with regards to formats and tools for monitoring and evaluation changed several times. On the level of AgESS short course delivery, though, there were ample and consistent examples of good management, forward planning, excellent communication, and general adaptability.

There was unanimous satisfaction with the AgESS short courses among all participants and stakeholders The adaptation of content to the context of Malawi and its multi-disciplinary approach were seen as the main contributions of the AgESS short courses. Participants in stakeholder interviews and focus groups reported positive perceptions of AgESS short courses processes including organization, communication and participant selection.

In terms of the internal operating and management systems, both the US partner and host country institution (HCI) respondents believed that the greatest strength of their partnership was its focus on inclusive, transparent, and empowering leadership. It was clear that a strong and collaborative relationship existed between the US partner and each HCI. The Malawian HCIs involved in this partnership did express that they perhaps could have collaborated more closely with one another and that closer collaboration among the Malawian institutions them would be beneficial in the future.