SUBMITTED TO:

PRO-POOR ECONOMIC GROWTH AND ENVIRONMENTAL SUSTAINABLE DEVELOPMENT POVERTY AND ENVIRONMENTAL INITIATIVE (PEI)

SUPPORT LGAs WORKING SESSIONS TO REFLECT P-E OBJECTIVES AND LESSONS LEANT FROM CHOLOLO ECO-VILLAGE TO BE TAKEN INTO THE NATIONAL AGENDA

Submitted by:

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Dr. Francis Bernard Njau and Hozen Mayaya of Institute of Rural Development, Dodoma and Michael Farrelly of Tanzania Organic Agriculture Movement, Dar es Salaam carried out this assignment. We thank the Economic and Social Research Foundation (ESRF) for giving us this work. Assistance, data and information contributions from different persons; Abdallah Hassan of ESRF, the staff of MAMADO, DONET, DMC, ARIH and Chololo Ecovillage community and Chololo village leadership during the mission is greatly acknowledged. Lastly we gratefully acknowledge the European Union for the financial support to Chololo Ecovillage project, The Ministry of Finance and Office of Vice President office, Division of Environment for their guidance during implementation of Chololo Ecovillage project. Without them Chololo Ecovillage as a model of good practice in Climate Change Adaptation and mitigation would not be there.
<table>
<thead>
<tr>
<th>Abbreviation</th>
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<tr>
<td>ARIH</td>
<td>Agriculture Research Institute Hombolo</td>
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<td>CVCA</td>
<td>Climate change Vulnerability and Capacity Analysis</td>
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<td>DDP</td>
<td>District Development Plan</td>
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<td>DMC</td>
<td>Dodoma Municipal Council</td>
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<td>DONET</td>
<td>Dodoma Environmental Network</td>
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<td>ESRF</td>
<td>Economic and Social Research Foundation</td>
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<td>ESS</td>
<td>Energy Saving Stove</td>
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<td>F2F</td>
<td>Farmer to Farmer</td>
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<td>FAO</td>
<td>Food and Agriculture Organisation</td>
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<td>FFLG</td>
<td>Farmer Field Leaning Group</td>
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<td>FFS</td>
<td>Farmer Field School</td>
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<td>FMNR</td>
<td>Farmer Managed Natural Regeneration</td>
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<td>GCCA</td>
<td>Global Climate Change Alliance</td>
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<td>GIZ</td>
<td>German Development Agency</td>
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<td>hrs</td>
<td>Hours</td>
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<td>ICRISAT</td>
<td>International Crop Research Institute</td>
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<tr>
<td>IRDP</td>
<td>Institute of Rural Development Planning</td>
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<tr>
<td>Kg</td>
<td>Kilogram</td>
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<tr>
<td>km</td>
<td>Kilometer</td>
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<td>LGAs</td>
<td>Local Government Authorities</td>
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<td>MAFC</td>
<td>Ministry of Agriculture, Food Security and Cooperatives</td>
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<td>MAMADO</td>
<td>Maji na Maendeleo Dodoma (Water and Development Dodoma)</td>
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<td>MsTCDC</td>
<td>MS-Training Centre for Development Cooperation</td>
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<td>NAPA</td>
<td>National Adaptation Program of Action</td>
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<td>NRM</td>
<td>Natural Resource Management</td>
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<td>OPV</td>
<td>Open Pollinated Variety</td>
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<td>P-E</td>
<td>Poverty and Environment</td>
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<td>PEI</td>
<td>Poverty Environment Initiatives</td>
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<td>PPP</td>
<td>Public Private Partnership</td>
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<td>PRA</td>
<td>Participatory Rural Appraisal</td>
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<td>SDGs</td>
<td>Sustainable Development Goals</td>
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<td>TOAM</td>
<td>Tanzania Organic Agriculture Movement</td>
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<td>TSZ</td>
<td>Tanzania Shorthorn Zebu</td>
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<tr>
<td>TV</td>
<td>Television</td>
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<tr>
<td>UNDP</td>
<td>United Nation Development Programme</td>
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<td>UNEP</td>
<td>United Nation Environmental Programme</td>
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<tr>
<td>USD</td>
<td>United States Dollar</td>
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<tr>
<td>VPO/DoE</td>
<td>Vice President Office/Division of Environment</td>
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<td>SEI</td>
<td>Stockholm Environmental Institute</td>
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EXECUTIVE SUMMARY

The main objective of this work was to document lessons learned from Chololo eco-village, to create awareness and understand the activities and approach that can be adopted by other villages in different districts and develop a guideline (from Chololo Eco-village) of best practices to be used for a scale up program in the 6 P-E districts.

The methodology used in this task includes documentary review and key informant interviews using content analysis as an approach for data analysis. The task was performed in a period of five weeks with three (3) deliverables namely an inception report, a draft guideline and the final guideline reflecting the outcome of the work.

Specific needs were identified in the sectors of environment and climate change, crop production, livestock production, fisheries and beekeeping in the districts of Bukoba, Sengerema, Bunda, Ikungi, Ileje and Nyasa. The specific needs were stopping environmental degradation through afforestation, use of alternative energy sources and use of fuel efficient cooking stoves, development of land use plans and bylaws, and capacity building in environment and climate change. In the agricultural productivity, the needs were on using good agricultural practices including climate smart agriculture; improving marketing and storage facilities; value addition and diversification. In the livestock sub-sector the specific needs are improvement of genetic potential of indigenous breeds through cross breeding with exotic breeds; diseases control; livestock infrastructures; access to markets; value addition of hides and skins; and preservation of pastures and crop residues for dry season feeding. In the fisheries sector, the districts specific needs include controlling illegal fishing through enforcement of bylaws and protection of restricted areas; promotion of fish farming using fish ponds and cage farming in Bukoba, Sengerama, Bunda and Nyasa; plant trees in restricted areas for fish breeding; and encouraging other income generating activities so as to reduce the overdependence of fishing activities. In the beekeeping, the district specific needs were to raise awareness on modern beekeeping; and stimulating investments in beekeeping.

The activities conducted in Chololo Ecovillage include synchronising the best planting time with respect to climate change. In this aspect the best planting time was from late December to early January. Other activities include use of good agricultural practices that conserve soil and water; use of farm yard manure to improve soil fertility; good land preparation through use of ox-drawn tillage implements; use of improved seeds; optimal plant spacing through correct spacing distance, thinning, and weeding; intercropping and crop rotation. Community seed production (Quality Declared Seeds) was done to ensure good supply of quality seeds within the village. Implementation of the named activities resulted into yield increase, meaning more household food security and income.
In the livestock sub-sector, the activities implemented by the projects were improving genetic potential of indigenous livestock breeds through introduction of improved Mpwapwa bulls, blended goat bucks, and improved cocks for cross breeding with local female livestock (cows, goats, and chicken). They activities were implemented alongside disease control and preservation of crop residues and hay for livestock keeping. In addition, activities such as value addition of hides and skins through vegetable leather tanning and making leather goods were also implemented. The improvement in the livestock sub-sector, especially goats and chicken, improved the income of livestock keepers through increase in sales (increased number of animals sold per year and better prices).

In the aspect of water, the village water supply is now powered with solar energy. The village primary school is harvesting rainwater through roof catchment capturing 60,000 litres of water in underground tanks. Subsurface and sand dams have been constructed to capture rainwater from seasonal rivers. These have increased water supply in the village and consequently leading to a reduction of women’s workload and time spent in fetching water. Furthermore, tree nurseries have been established to provide tree seedlings for planting around households, churches, primary school, dispensary and in the village forest reserve.

The village land use plan and environmental by-laws have been developed which identified and allocated suitable areas for crop and livestock production, settlements, conservation, and beekeeping among others. The village land use plan has been developed to protect the village forest and avoid conflicts between livestock keepers and farmers.

In the energy sector, the main activities implemented were the introduction of energy saving stoves (ESS) and domestic biogas digesters (DBD). The ESS and DBD reduces the amount of firewood use by almost 50 percent and 100% respectively as compared to the amount of fuel wood used for cooking using the traditional three stone fire.

The approaches used in implementing the Chololo Ecovillage project were the participatory approach in identifying, implementing and evaluation of the project; and a holistic approach that considered all major aspects of rural community life such as agriculture, livestock, water, energy and natural resources. Public private partnership was considered where project implementers came from public organisations and NGOs. The importance of such partnership was to ensure efficiency and multi-disciplinary delivery, as each implementing partner had a specific speciality. Other approaches were aligning the project to the national priorities; attaching relevance of the action to the beneficiaries; flexibility to innovate and diversify; and good project management and coordination.

Lessons learned from Chololo Ecovillage project in relation to community adaptation and mitigation practices include:
• The efforts to address climate change in particular through community adaptation and mitigation practices should take a holistic approach whereby the focus should encompass all livelihood sources rather than focusing on single or just few issues;

• Some innovations to address climate change that are effective, gender focused and affordable can easily be implemented using local resources and institutions;

• Effective engagement of community members including capacity building to their local institutions is critical for successful implementation of the various innovations and

• Some solutions (community seed production, forest management, beekeeping, leather making, biogas, bulls, goat bucks, land use planning, sand/subsurface dam, fish farming, water resource management, and roof catchment water harvesting) used in empowering local communities to adapt and mitigate climate change are capital intensive. In this regard, resources availability is critical in realizing intervention objectives.

Despite of the successes of Chololo Ecovillage project, some challenges were encountered during its implementation. These were institutional and sector specific challenges. The institutional challenges involved the delay of start date for the project implementation and complexities in working in partnership taking into consideration that each of the six implementing partners had their own organisational styles, abilities and ways of working. However, the named institutional challenges were resolved by adjusting the schedule of activities with high priority given for rain dependent activities while non-rain dependent ones were put on hold. Implementation challenges at sectorial level were experienced in the areas of agriculture, livestock keeping, water, energy and natural resources. In crop production, the key challenges were related to difficulties in supply of improved seeds and use of push-pull technology. In the livestock sub-sector, the key challenge was the introduction of young immature bulls due to cost implications. Prolonged dry spell, invasion of uncontrolled livestock also affected the establishment and performance of planted pasture. Challenges in the water (rainwater harvesting infrastructure and resistance to change to solar pumping), energy (slow adoption of energy saving stoves and high cost for the construction of domestic biogas digester), and natural resources (tree planting survival rates and disputes experienced during development of village land use plan) were also encountered during project implementation. Despite of the existence of both institutional and issue specific challenges, strong commitment, flexibility, mutual respect, use of participatory approach and good coordination played a key role in resolving the project implementation challenges.
Gender was considered in all aspects of the Chololo Ecovillage project from planning, implementation and monitoring. This enabled this disadvantaged group (women) to participate fully, improve their productive use of time and resources, and substantially increase their income from sales of goats and chickens.

Based on Chololo Ecovillage experience, the guideline in this report is subdivided into two parts namely the general and specific guidelines. The general guideline provides guidance on issues such as selection of a multidisciplinary team for project implementation, problem identification, and selection of representative ward, sensitization, and integration of gender issues in all aspects of project planning. The specific guideline on the other hand provides practical guidance on specific areas for intervention. These include guidelines on agriculture (crop and livestock production), natural resources, energy, water, and development of village land use plan. Others topics include integration of poverty, environment, climate change and gender into district development plans, multiplier effects and sustainability assurance.

In conclusion, the problems of environment and major economic activities experienced in Sengerema, Bunda, Bukoba, Ikungi, Ileje and Nyasa districts are not significantly different from Chololo village. Therefore the Chololo Ecovillage model can be used for scaling up the good practices to other places. The guidelines developed are based on Chololo Ecovillage experience and the unique differences that exist in the 6 PE districts.
1.0 INTRODUCTION

Endowment of natural resources in Tanzania and in particular the 6 PE districts (Bukoba Rural, Sengerema, Bunda, Ikungi, Ileje and Nyasa) offer a special window of opportunity in addressing economic growth and environmental challenges. Efficient utilization of such resources can lead to the realization of their full potential in reducing poverty, conserving the environment and promoting sustainable livelihood. At the heart of the successes in poverty reduction and promotion of sustainable livelihood is the need for proper management of environmental resources. Against this background, the UNDP/UNEP supports pro-poor economic growth and environmentally sustainable development programme that focuses on poverty reduction, sustainable economic growth.

The Poverty – Environment Initiative (PEI) of the United Nations Development Programme (UNDP) and the United Nations Environment Programme (UNEP) offers an opportunity in supporting country-led efforts to mainstream poverty-environment and gender linkages into various national arenas such as development plans, policy making to budgeting, implementation and monitoring. The programme provides technical and financial assistance to state and non-state actors to manage the environment in a way that sustain both livelihoods and economic growth.

The key challenge towards effective pro-poor growth is inadequate coordination of institutional mechanisms and processes especially those related to sectors and district plans and budgets. In this regard, the need to strengthen existing national planning, budgeting, monitoring at national, sector and local level is unavoidable. It is on this basis, the Poverty and Environment Initiative (PEI) 2014 -2017 among other issues focuses on enhancing national and district (LGAs) capabilities to mainstream and implement environmental sustainability, poverty reduction, and gender and climate issues into development plans and develop a better architecture for financial mechanisms in Tanzania.

Nevertheless, the implementation of interventions aimed at achieving the broad PEI goals has remained a challenge despite some achievements already registered by the programme since 2003/2004 when the programme was launched. The implementation challenges are mostly associated with inadequate resources and re-investment in relevant sectors critical for economic growth in Tanzania.

The 6 PE districts, being among the many districts in Tanzania characterised by both poverty and environmental degradation, offer a special opportunity to the UNDP/UNEP’s pro-poor economic growth and environmentally sustainable development programme to change the current livelihoods, economic situation and environmental management.
**Chololo Ecovillage** is among the few ecovillages in Tanzania that have been implementing climate change adaptation and mitigation initiatives. The results from the implementation of the Chololo Ecovillage project have been outstanding both at the national and local levels as declared by Dr. Julius Ningu (Director of Environment - Vice President’s Office) and Mr Michael Mbungi (the Chololo Ecovillage Chairperson).

**Testimony from VPO/DoE**

“Tanzania is highly vulnerable to the impacts of climate change, and adaptation is our highest priority. More than 80% of the population depends on climate sensitive rain fed agriculture for their livelihood. Reducing vulnerability to climate change through different mechanisms is crucial for strengthening socio-economic development and assurance of food security.

Chololo Ecovillage as an exemplary is empowering communities to test, evaluate and apply a wide range of adaptation innovations in key sectors such as agriculture, livestock, water, energy and forestry. The project is providing practical solutions to the climate challenges as it works across several sectors. Through a holistic approach the project is breaking new ground, achieving synergies and strengthening the knowledge base of good practice in climate change adaptation, while reducing carbon footprints.

The National Climate Change Strategy encourages such initiatives to build the critical mass of expertise to address adaptation challenges, while safeguarding precious natural resources and strengthening the country’s voice in the global climate change debate.”

*Dr Julius Ningu, Director of Environment, Vice President’s Office.*

**Chololo Village Chairperson reflects on the ecovillage project**

“The benefits that we got from the Chololo Ecovillage project are many: We didn’t know about good agriculture practices, but now after being trained we are using improved seeds, cultivating farms with ox-plough, applying farm yard manure, planting at the right time with proper spacing, weeding and thinning. This enabled us to get higher yields than before in almost all important crops.

“Our livestock management practices have improved. Livestock keepers are preventing disease and treating their livestock using vaccines, acaricides and various livestock drugs. They are also preserving feed for their livestock for dry season feeding.

“Rainwater harvesting through roof catchment at the school is providing water for the school and surrounding community. The solar pump has made water available every day of the year.

“Modern beekeeping provides us more honey than traditional beekeeping. Villagers are now keeping fish at home for household use.
“In my village everybody has benefited from the project. This is because within the three cropping seasons everybody in the village was able to get improved seeds. Also water from the solar pump is reaching everybody in the village. Besides that, neighbouring villages are also getting water from our village.

“I assure you that in the two years of Chololo Ecovillage project, our village was free from hunger and according to the good condition of the farms in this year 2013/14, my village will get more yields that in the previous two years.

“In my village everybody has benefited from the project. Nobody is going out of the village in search of food. Those who have shortage get food within the village from farmers who have enough to spare.”

Michael Mbumi - Village Chairperson.

In general, the 6 PE districts face various challenges that affect their efforts towards realizing their economic growth potentials. The major challenges include environmental degradation such as severe land degradation and land cover depletion; climate change leading to severe impacts on agriculture, forestry, water and biodiversity sectors; decline in agricultural productivity; illegal and unsustainable fishing practices (in Nyasa, Bunda, Sengerema and Bukoba districts); weak institutional support; and difficulties involved in implementing environmentally friendly activities such as beekeeping.

The above named challenges are common in the 6 PE districts despite their vast endowment of natural resources with the potential of addressing economic growth and environmental management issues. This work therefore uses the Chololo Ecovillage experience with special focus on activities, approaches and lessons learned, gender mainstreaming, and challenges and barriers that the project encountered to develop a guideline that can be used in the 6 PE districts in promoting pro-poor economic growth and environmental sustainability.
2.0 TERMS OF REFERENCE

Based on the TOR, the specific tasks of the assignment include:

- Identifying specific districts’ needs from Assessment and Mapping Studies, MAF and other relevant reports on environment, climate change, agriculture, fisheries and beekeeping that can benefit from the experience of Chololo Ecovillage, and other experiences in Tanzania and outside;

- Liaising with the Institute of Rural Development Planning (IRDP) in Dodoma and Chololo Ecovillage, to understand the activities, approach and document the lessons that can be learned and scaled up the P-E districts;

- Documenting the challenges and barriers that the project encountered that led to failure of some of the activities or delays in achieving the outcomes and how they were overcome;

- Developing a guideline basing on Chololo experience, that will support villages in six project districts in the country to take up climate change mitigation and adaptation technologies in agriculture, livestock, water, energy, and natural resources;

- Document how gender was mainstreamed in the Chololo Ecovillage project, to address gender imbalances in the village, and involvement of women in agriculture, livestock keeping, energy, water, and natural resources and

- Presenting the guideline to the team of experts from; POPC, UNDP, UNEP, VPO, Ministry of Natural Resources, Ministry of Agriculture, etc for validation.
3.0 CONSULTANT TEAM AND METHODOLOGY

3.1 Consultant Team

The consultancy work was done by Hozen Mayaya, and Michael Farrelly under the supervision of Dr Francis Bernard Njau. All the team members were involved in the implementation of Chololo Ecovillage project and are expecting to start phase two of the Ecovillage project.

3.2 Review Methodology

3.2.1 Documentary Review

In implementing this assignment a documentary review was done. The documents reviewed include the survey reports based on studies conducted in the 6 P-E districts, Chololo Ecovillage project reports, relevant government reports and Chololo Ecovillage evaluation reports among others. Secondary data were gathered from assessment and mapping studies and other relevant reports on pro-poor economic growth and environment for qualitative analyses.

3.2.2 Key Informant Interviews

Key informant interviews involved face-to-face interviews with Chololo Ecovillage project implementation partners, including the Institute of Rural Development Planning, Dodoma Municipal Council (DMC); Agricultural Research Institute Hombolo (ARIH); Maji na Maendeleo/Water and Development Dodoma (MAMADO); Tanzania Organic Agriculture Movement (TOAM) and Dodoma Environmental Network (DONET). The interviews were crucial in tapping their experiences and understanding of project challenges and barriers and how such challenges were addressed. The interviews also targeted other stakeholders directly involved in the project activities including residents of Chololo Ecovillage.

3.2.3 Data Analysis

The data and information gathered through documentary review and key informant interviews, was analyzed using ‘content analysis’ approach, organized and compiled under various themes addressed as indicated in the TOR.

3.2.4 Deliverables

Based on the TOR, the key deliverables of this assignment are as follows:

- An inception report
- A draft guideline, and
- A final guideline reflecting the outcome of the work
3.2.5 Submission of draft and final report

The draft report was presented to the team of experts from; POPC, UNDP, UNEP, VPO, Ministry of Natural Resources and Tourism, Ministry of Agriculture Food Security and Cooperatives and others for validation at the workshop that was held in Dar es Salaam. The comments from the validation workshop were incorporated into the final draft before submission to the client (ESRF).

3.2.6 Work Plan

Based on the focus issues raised in the Terms of Reference (TOR) the work plan is as follows:

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<tr>
<th>Activity</th>
<th>Week 1</th>
<th>Week 2</th>
<th>Week 3</th>
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<th>Week 5</th>
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<tr>
<td>Writing and submitting an inception report</td>
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<td>Identifying specific districts’ needs in relation to climate change,</td>
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<td>agriculture, fisheries and beekeeping that can benefit from the</td>
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Note: The benchmark for the weeks indicated in the work plan starts immediately after signing the contract on 12th November 2014
4.0 CONSULTANTS OBSERVATIONS/FINDINGS

This section presents the findings based on the specific tasks stipulated in TOR. The findings include:

- district specific needs that can benefit from experience of Chololo Ecovillage and other experiences from Tanzania and outside;
- activities and approaches used in Chololo Ecovillage, and the key lessons that can be learned and scaled up to the 6 project districts;
- challenges and barriers that the project encountered that led to failure of some of the activities or delays in achieving the outcome and how they were overcome;
- a guideline based on Chololo experience, that will support villages in six project districts in the country to take up climate change mitigation and adaptation technologies in agriculture, livestock, water, energy, and natural resources; and
- gender mainstreaming issues based on Chololo Ecovillage experience so as to understand ways used to address gender imbalances in the village, and involvement of women in agriculture, livestock keeping energy, water, and natural resources.

4.1 District specific needs that can benefit from the experience of Chololo Ecovillage and other experiences from Tanzania and outside

Successful interventions on the 6 PE district depends on understanding the specific district need (ESRF, 2014) that can benefit from the experience of Chololo Ecovillage. Challenges in the 6 PE districts are multidimensional in nature and hence the interventions should respond to an array of different but interconnected issues. The main issues identified alongside Chololo Ecovillage experience include environment and climate change, agriculture (crop production and livestock), fisheries, and beekeeping.

4.1.1 Environment and Climate Change

The economies of the 6 PE districts mainly depend on the agriculture sector with more than 85% of the population depending on crop cultivation and livestock keeping. The level of agricultural mechanization is very low with a large proportion of farmers largely depending on hand hoes for land preparation. The agriculture sector has been negatively affected by a number of factors such as poor climatic conditions, rain-fed agriculture, and poor physical infrastructure (roads in particular), and poor marketing. With these problems agricultural productivity is low and cannot meet the household needs. Fifteen percent of the work force in the districts engage in other activities such as timber, fishing, small industries (sunflower oil) and small-scale mining activities. This to a large extent has affected the incomes of the people and the districts as a whole because the majority (85%) of the people who are engaged in agriculture do not earn enough income. Average annual income per capital in Ikungi District is Tshs 350,000 by 2011, and Tshs 660,000 per year in Nyasa District. The
districts’ population mainly depends upon biomass – firewood, charcoal and crop residues - to meet their basic energy needs for cooking, brew making, brick making, and fish smoking in districts along Lake Victoria (Sengerema, Bunda and Bukoba Rural) and in Nyasa District.

The overdependence of firewood and charcoal as the main source of energy and unsustainable agriculture practiced by majority of farmers in the districts has led to environmental degradation manifested through deforestation. This deforestation has resulted in land cover depletion, severe land degradation leading to loss of soil fertility, declining water resources, has reduced agricultural productivity, and increased the scarcity of water, scarcity of firewood and building material and is exacerbating poverty. Stockholm Environmental Institute (2010; 2012) observed the same in the whole country of Tanzania. In addition, environmental degradation is accelerated by absence of village land use plans and environmental by-laws.

To stop environmental degradation the districts need to introduce the following measures:

- **Demarcation and zonation of degraded land for conservation and afforestation:** This can be done through conservation of natural forest through planting trees, Farmer Managed Natural Regeneration, agroforestry, woodlots and tree planting at community level, individual household and farm boundaries;

- **Use alternative energy sources and use fuel-efficient cook stoves:** The alternative energy sources include use of solar power, which is available all the year around for cooking and lighting, and use of biogas from livestock dung which is readily available from livestock keepers. The use of energy saving stoves can reduce by half the amount of firewood needed to cook, and thereby reduce pressure on forest resources, while saving women time and effort used for firewood collection, and reducing harmful smoke in the household;

- **Land use plan and Forest management plan:** These plans will reduce the degradation of land forest and ecosystem, and help avoid conflicts between different land user groups by allocating land for agriculture, grazing, settlements, forests and recreation;

- **Environmental bylaws:** The environmental bylaws need to include land use and forest management bylaws. The bylaws will reduce the improper land use that result in degradation of land, forest and ecosystem as well as generating conflicts among different users. Also the bylaws, if well enforced, will empower communities to take control and care of their natural resources;

- **Training on environment, climate change and formulation of environmental by-laws:** Most of the staff and leaders of the six PEI districts have limited knowledge in
environment, climate change and formulation of environmental by-laws. This limits their ability to formulate and implement activities for protecting the environment, climate change adaptation and mitigation and by-laws. In view of this, the districts need capacity building in environmental protection, climate change planning, and formulation and enforcing of by-laws and

- **Rainwater harvesting and aquifer water drilling:** Invest in rainwater harvesting equipment and aquifer (well/borehole) water drilling machinery, extraction, water treatment and distribution for domestic use, and technologies for purification to remove suspended solids, micro-organisms and toxic chemicals; secure, conserve and sustainably use water.

### 4.1.2 Agriculture

#### 4.1.2.1 Crop production

Crop farming is the main economic activity in the Ikungi, Sengerema, Bunda, Bokoba and Ileje districts. In the Nyasa district, crop farming is the second economic activity after fishing. Crops grown in Ikungi district include sorghum, pearl millet (drought tolerant crops), finger millet, sweet potatoes, cassava and pigeon peas. Others include sunflower, cotton, onions and lentils, groundnuts, and to little extent paddy. In Bunda district the crops grown are maize, sorghum, and cassava as food crops and cotton as a cash crop. In Sengerema, the crops grown are maize, paddy, sorghum, cassava, sweet potatoes, pulses beans as food crops. In Bukoba they grow banana, cassava, sweet potatoes, maize, beans, rice, sorghum and millet as food crops and coffee, sunflower, vanilla and horticultural crops as cash crops. In Nyasa district they grow cassava, maize, paddy, wheat, pearl millet and sweet potatoes as food crops. Coffee and cashewnuts are grown as cash crops. Of the six districts, Ileje district grows a wide variety of crops. They grow maize, paddy, beans, groundnuts, Irish potatoes, sweet potatoes, pearl millet, finger millet, plantains, cassava and horticultural crops. They also grow coffee, pyrethrum, sunflower, cardamom and cocoa as cash crops. Most of these crops are grown in about 1-5 acres of land per household. The productivity of these crops in general is low in almost all districts because of the following problems:

- Limited use of good agriculture practices including climate smart agriculture
- High crop losses due to pests and diseases and poor post harvest management
- Climate change impacts such as drought, floods and unreliable rainfall
- Inadequate marketing, marketing information and value adding skills
- Lack of irrigation skills and facilities
- Lack of education in climate change adaptation skills
- Inadequate access to farm implements, improved seeds and improved technologies
- Lack of agro processing facilities for value addition e.g., rice and maize mills
• Lack of modern storage facilities; in Ileje district for example this is causing a lot of post harvest losses.

These problems contribute significantly in making the farmers poor because even in good years where there is good rainfall and farmers have harvested enough produce, marketing problems arise, prices drop below the production costs, and the farmers have poor quality storage facilities, leading to high post harvest losses.

**Districts needs in crop production**

In order to remove or reduce these problems the following is needed:

• Improved knowledge in climate change adaptation and mitigation for both local government officials and farmers;
• Knowledge and practice of climate change adaptation techniques such as Good Agriculture Practices (GAP) including climate smart agriculture (Proper planting time, drought resistant high yielding seeds, improvement of soil physical structure, correct spacing, intercropping, organic fertilizer use in small farms (<5 acres), contour farming etc);
• Improvement of post harvest handling including storage structures (warehouse);
• Rainwater harvesting and use of underground, river or lake water for irrigation;
• Strengthen the use of ox-drawn farm implements such as ploughs, magoye ripper, ridgers etc.;
• Improved marketing skills and capabilities;
• Investing in value addition of agricultural produce to increase value and catch wider market;
• Diversification – reduce reliance on one crop and grow different type of crops. For example, in Bukoba farmers were relying on banana as the main food crop but due to climate change, the banana wilt disease has killed most of the banana. People now are using other sources of carbohydrates as their staple food. Also they need to take up more diverse economic activities to reduce dependence on rainfed agriculture;
• Development and enforcement of bylaws that promote Good Agricultural Practices (sustainable agriculture);
• Integrate climate change adaptation and mitigation in district development planning; this will increase sustainability of the activities on environment, adaptation and mitigation in the districts.

**4.1.3 Livestock**

Livestock is the second main economic activity to the districts of Bunda, Sengerema, Bukoba, Ileje and Ikungu. In Nyasa district livestock is not a predominant occupation. The main livestock breeds kept in these five districts are local livestock breeds of cattle, goats
and poultry and pigs to some extent. The Tanzania Shorthorn Zebu cattle are kept in all districts but the Ankole cattle are found mostly in Bukoba. The indigenous breeds of cattle are kept mainly for meat production though they contribute significantly in milk production. Report by Ministry of Livestock and Fishery Development (2011) shows that about 70% of the milk produced in Tanzania comes from the traditional sector (indigenous cattle) kept in rural areas, the remaining 30% comes from improved cattle mainly kept by smallholder producers. The high contribution of indigenous cattle in milk production in Tanzania is because of its number but not on its potential in milk production. The milk production potential of Tanzania Short Horn Zebu is reported to be only between 530 to 950 kg per lactation of 232 – 257 days (Msechu et al, 1987 and Msechu, 1988). Goats and chicken kept in these districts are also of indigenous type, which also have low genetic potential in terms of milk, meat and egg production. Improved breeds of cattle, goats and chicken with high production potential are also kept in these districts by few farmers.

The major problems of livestock in these six districts include:

- Poor genetic potential of the indigenous breeds failing to produce enough milk, meat and eggs and therefore having low economic contribution;
- Livestock pests and diseases; mainly tick born diseases (East Coast Fever, Anaplasmosis and Heart water), Trypanomiasis and Helmithiasis for cattle and goats, Newcastle Disease for chicken. These diseases limit the productivity of these livestock;
- Inadequate livestock health services including supply of drugs, vaccines and infrastructure (dips, veterinary centres, crushes, hides and skin sheds, slaughter slabs, livestock markets, charcoal dams and abattoirs;
- The impacts of climate change especially drought has resulted in shortage of water and pastures for livestock in years where there was low rainfall. This causes some livestock to die or migrate to other areas for searching pastures and water;
- Inadequate marketing and value addition of the livestock products (meat, milk, eggs, hides and skins) results in low prices for livestock products. A good example is hides and skins which are sold at around Tshs 5,000 for hides and Tshs 1000 for skins
- Lack of Land Use Plans in the villages;
- Market information: Livestock keepers rely on the local markets to sell their livestock, often selling at low prices while at regional/city or town markets the prices are higher. Access to livestock market information could improve incomes from livestock sales.

**District needs on livestock production**

In order to improve the livestock sector in the 6 districts, the following is needed:

- Improve genetic potential of the indigenous breeds by introduction of bulls of improved cattle breeds of Mpwapwa, Friesian, Aryshire etc (this needs to be handled with sensitivity and respect for local cultural preferences, esp Ankole longhorn);
Bucks of improved goats breed of either Alpine, Saanen, and Toggenburg or blended goats and improved cocks. The improved male livestock will mate with local breed females to produce offsprings (F1) which will have high genetic potentials as compared to the local breeds;

- Trainings on improved livestock management and disease control;
- Investments in infrastructures such as dips for tick born disease control, charcoal dams for livestock water, livestock markets and abattoirs;
- Value addition of hides and skins through vegetable leather tanning. This will increase the value of hides and skins;
- Develop feeder roads for easy transportation of livestock and crop products;
- Develop village land use plans which will allocate areas for grazing livestock and for other purpose to avoid conflicts;
- Improvement of livestock feeds through pasture establishment and preservation of pastures and crop residues for dry season feeding;
- Improve access to market information

4.1.4 Fisheries

Fishing is the third major economic activity after agriculture and livestock in Bunda, Sengerema and Bukoba. In Ikungi fishing practice is very low but there is a potential for fish farming. Fishing is not reported in Ileje district. In Nyasa District fishing is the major economic activity. It is a main economic activity of the community surrounding Lake Victoria and Lake Nyasa. It is perhaps instructive that the importance of Lake Victoria and Nyasa (and its fish resources) to the lives of the people in these areas is so high. But now with dwindling fish stocks, the level of poverty is rising fast. For example poverty in Nyasa district is mainly due to inability to cope with environmental and socio-economic changes and failure to come up with alternative means of livelihood as the majority of people are over reliant on Lake Nyasa fishing. Fishing was a quick win economic activity with immediate returns; but now the fish stocks are decreasing at a very fast rate due to changes in the Lake ecosystem and degradation of hatching habitats. Generally the challenges facing the fishing industry in Lake Victoria and Nyasa districts include:

- Illegal fishing – i.e. use of unauthorized methods/means of fishing e.g. use of smaller sizes of fish net which catches the young fish not intended /or not allowed, and use of drugs or agro-chemicals to poison fishing grounds, e.g. Thiodan; fishing in restricted areas such as breeding areas;
- Pollution of water sources, extensive agricultural methods resulting in siltation of the lake, deforestation along lake shores etc.;
- Presence of lake/sea weeds – aeration in the lake waters becomes poor and affects fish stock.
**District needs on fishing**

To improve fishing activities the following need to be done in the 6 districts:

- Promote fish farming and cage fishing as an alternative source for supply of fish, income generation, for enhancing food and nutrition security, and for minimizing illegal fishing practices/activities and minimizing degradation of aquatic ecosystems in rivers and lakes;
- Establish a fish value chain and encourage the participants to share information, know how, resources, and collaborate in investing in supporting facilities and services such as boat building, supply and maintenance of fishing gears and equipment, construction of quality landing sites and markets, refrigeration, transport, and cold storage;
- Improve fishing techniques for artisanal fishers to reduce post-harvest losses;
- Strengthen regulatory frameworks in the fisheries sector;
- Protect the restricted area and plant appropriate trees for improvement of fish breeding area;
- Deliberately remove the lake weeds for improving the aeration of water for fish; and
- Encourage other income generating activities to reduce overdependence and overfishing of the lakes. This particularly applies to Nyasa District where fishing at Lake Nyasa is the main economic activity.

**4.1.5 Beekeeping**

Beekeeping is not considered as a main economic activity in the 6 surveyed districts. However, in all 6 districts there is potential of beekeeping investment because of availability of forest (natural and reserved forests). Beekeeping sector can play a major role in socio-economic development and environmental conservation. Despite its potential significance in socio-economic development, the beekeeping sector is still in its infancy due to lack of awareness among residents to adopt modern production, processing and packaging technologies and practices. Proliferation of beekeeping may enhance afforestation, and reduce deforestation and disruption of the ecosystems since the beekeepers will be motivated to protect against bush fires and illegal cutting of trees.

**Districts needs on beekeeping**

- Stimulate investments in beekeeping, honey, wax and other products to provide high return and profitable opportunities to both small and large scale investors;
- Raising awareness among residents to adopt modern production, processing and packaging technologies and practices e.g. production of modern beehives; equipment and facilities for honey collection, processing and wax production; and
• Providing training on modern beekeeping, extension services, research services, and marketing support to expand cost-effective production and marketing of safe and high quality bee products.

4.2 Activities Employed to Improve Climate Resilience in Chololo Ecovillage

Chololo Ecovillage is a part of The Global Climate Change Alliance (GCCA), an initiative of the European Union. The GCCA is a global alliance with a focus on helping the most vulnerable developing countries to more effectively address the challenges associated with climate change. Developing countries have contributed the least to greenhouse gas emissions, but are often the most affected by climate change and have limited resources to address the challenges.

The National Climate Change Strategy has identified agriculture, water, energy and forestry as some of the most climate change-affected sectors. The situation is directly affecting the most vulnerable populations, often in the rural, remote, drought-prone and food-insecure areas of the country. Women in particular are sharing a great deal of the burden because of their low adaptive capacity to environmental risks and their social/household roles.

Chololo Ecovillage is one of three projects in Tanzania selected from a GCCA call for proposals, one in each of three types of ecosystems (coastal, drylands, and highlands) particularly vulnerable to climate change. The call for proposals aimed to increase the capacity of the most vulnerable communities to adapt to the adverse effects of climate change through sustainable use of their natural resources. Specifically it called for an eco-village approach, where holistic, innovative and integrated approaches are tested, adopted and shared.

The 32 month project launched in September 2011 and was completed in May 2014. Chololo Ecovillage project was delivered by a partnership of six organisations, led by The Institute of Rural Development Planning (IRDP). The partners are Dodoma Municipal Council, Dodoma Environment Network (DONET), Hombolo Agricultural Research Institute, Maji na Maendeleo Dodoma (MAMADO) and Tanzania Organic Agriculture Movement (TOAM). The contracting authority is the Tanzanian Ministry of Finance & Economic Affairs (European Development Fund).

The response to such a wide range of negative effects must be holistic, integrated, multi-disciplinary and community-based.

The project activities worked across the five sectors of agriculture, livestock, water, energy, and natural resources.
4.2.1 Agriculture

4.2.1.1 It’s all about timing

Paradoxically the cheapest intervention is probably the most important. It costs nothing, yet it has made a huge difference to food security in Chololo. It’s all about timing!

Planting time is crucial. In the past, the first rains signalled the start of the rainy season and farmers were encouraged to plant their seeds as early as possible. The popular national farming slogan from the 1970s was “Mvua za kwanza ni za kupandia” (“The first rains are for planting”). However, the changing climate has disrupted the pattern, with farmers now reporting that the rain season is less predictable, starting later, finishing earlier, leading to low productivity or crop failure, food shortage or famine.

A study on drought and famine in Dodoma found that the presence of dry spells at critical periods of crop development contributes considerably to crop failure. Recent rainfall data shows the dry spell occurs around February and lasts for a month or so.

The way it works is that when planted early – at or even before the start of the rains - the seeds either germinate then die as the predicted rains fail to materialise, or they survive but later enter the dry spell in February at the critical ‘flowering’ period in their development when they need adequate soil water supply, and so they wither and die.

The solution we have found in Chololo is to resist the temptation to plant early, and wait 3-4 weeks until late December – early January. Seeds planted in January will have not reached flowering stage by February when the dry spell hits, so they do not need much water and can survive a few weeks without rain, reaching flowering stage in March when the rains return and guarantee a good harvest.

“Initially I was planting my farm haphazardly. I was planting in the dry season when the first rains come in November, and seeds can germinate and dry or die. But after being trained I am now waiting for the big rains, then I plough my farm, plant my crops in proper spacing and now the yields of crops have increased.”

Stefano Chifaguzi, Chololo Farmer

4.2.1.2 Good Agriculture Practices (GAP)

Traditionally, farmers in Chololo practiced shifting agriculture using “kuberega” slash and burn methods. Often a field was planted with the same crop year after year, and crop residues were burned. When the soil was depleted of nutrients, the farmer would shift to a new field, cutting down the trees to clear the land, and preparing for planting using hand hoes. Farmers planted seeds saved from the previous year’s harvest, and hoped that the
crops would survive. Now there is no more room for expansion, and for most farmers the often-recycled seeds have low yield potential.

The project has introduced a package of ecological agriculture technologies to make the most of the limited rainfall, improve soil fertility, reduce farmers’ workload, and improve the quality of local seeds.

**Ox-drawn tillage implements** like the Magoye Ripper reduce farmers’ workload when preparing the land, and improve rainwater harvesting in the dry hard-pan soils.

**Soil water conservation measures**, like contour ridges, fanyajuu bunds, grass strips, and gully healing, all help to capture rainwater and prevent soil erosion.

**Farmyard manure improves soil fertility**, supplying the crops with nutrients, improving the soil structure and water holding capacity.

**Improved early-maturing, high-yielding seed** varieties of maize, sorghum, millet, cowpeas and groundnuts have rejuvenated the village seed system.

**Optimal plant population** with correct spacing distance, then thinning and weeding, reduces competition between plants and improves yields.

**Community seed production** ensures that a good supply of quality seeds is available for planting each year.

**Intercropping and crop rotation** improve yields per acre and help control weeds, pests and diseases.

“The project has changed me. In the past I was not using farmyard manure in my farm but now it is a great resource. I am using it in my farms. Combined with Good Agricultural Practices I am now getting enough food for my family and surplus for sale.” Gilbert Masiga, Chololo farmer

**4.2.1.3 Good land preparation improves soil and water conservation**

Fertile land and sufficient water are vital for sustaining agriculture and farmers’ livelihoods. Lack of water reduces the ability of the soil to supply nutrients to growing plants.

In Chololo, as in many parts of Tanzania, productivity of land has been decreasing due to land degradation, caused by unsustainable agricultural practices like farming on slopes without sufficient use of soil and water conservation measures, mono-cropping, excessive tillage, non-replenishment of soil nutrients, burning of crop residues, conversion of forests
to agriculture, over-exploitation through fuel wood and timber harvesting, overgrazing of rangelands, and lack of proper soil organic matter management.

Traditionally Chololo farmers (men and women) prepared their fields paying little attention to the maintenance of soil fertility, soil erosion control, and rainwater harvesting. Combined with climate change impacts of erratic rainfall, increased temperature and higher winds, the result has been declining soil fertility, increased soil erosion and gully formation, and loss of soil moisture through surface runoff and evaporation.

The project trained around 400 farmers in improved land preparation practices, including animal power tillage, soil water conservation techniques, and use of farmyard manure. Eighty farmers were trained on tillage techniques that enhance in-situ rainwater harvesting on cropland, fabrication of ox yokes, training of oxen, and practical use of ox tillage implements. Sixty farmers were trained on soil water conservation techniques like contour ridges, grass strips, trash lines, “fanya juu”, “fanya chini”, infiltration ditches, and the use of A-frames and line levels to accurately plot land contours. Farmers were shown how to prepare seedbeds across the slopes which minimizes runoff and enhances soil moisture. One hundred and forty farmers were trained on gully healing to tackle the massive problem of soil erosion through gullies which form after the rain.

Chololo farmers now realise that the use of these methods leads to reduced land degradation, more fertile soils, increased soil moisture, and increased sustainable production. A major shift from traditional “slash and burn” to improved land preparation methods has been seen across the village.

“I advise other farmers to follow good agricultural practices to avoid frequent food shortage because with the climate change we need to follow good agriculture practices. Preparing land with ridges, using Magoye ripper / ridger, and planting seeds with correct spacing. With Magoye ripper you can cultivate in hard pan. After cultivation you harvest rainwater and your seeds will all germinate and withstand drought. I advise other people with their farms in sloping areas to use ridges to capture water flowing down the slope, and prevent soil erosion.”

Keneth Ndalu, Chololo Farmer

4.2.1.4 Improved cropping systems increase yields and incomes

Improved seeds: With climate change, rainfall patterns have become erratic and unpredictable, with the rain season starting later and finishing earlier. Agricultural research institutions have developed a range of low-cost improved seed varieties to adapt to the challenges of climate change.
The improved seeds are bred to be more drought resistant, high yielding and early maturing. Chololo farmers were supplied with a range of these seeds to test and evaluate, namely sorghum (Macia and Pato variety), pearl millet (Okoa variety), cowpeas (Vuli 1&2), groundnuts (Pendo variety), and sunflower (Record variety).

The Macia variety sorghum seeds, for example, were developed in Tanzania by local scientists supported by ICRISAT – the International Crop Research Institute for Semi-Arid Tropics. The plants reach maturity in only 3.5 months, are high yielding with short stems and a large head, and provide green leaves for animal fodder. All the seeds are ‘open pollinated’ (not hybrids) so they can be recycled by farmers year on year.

**Intercropping** makes better use of resources, provides higher yields per unit area, hedges against single crop failure, and helps protect against pests and diseases. Mixing two crops in the same field, for example a cereal-legume mixture of millet or sorghum with cowpeas or groundnut, reduces depletion of individual soil nutrients, replaces nitrogen, and can reduce pest damage. It provides a family with a balanced diet of staple grains, protein-rich beans, and green leaves for essential vitamins.

> “I was trained on intercropping as a means of adapting to the impacts of climate change. The project gave me sorghum and cowpea seeds. I planted them in rows in proper spacing in January 2014. By early March the sorghum plants were starting to flower, and the cowpeas were fully matured and I started to harvest leaves and beans for my family. I expect to get enough yields in both cowpea and sorghum. I advise other farmers to use intercropping”.

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**Minza Chiwanga, Chololo farmer**

**Crop rotation** – planting different crops in a field each year – reduces depletion of soil nutrients (soil mining), and reduces insect pest attacks.

> “Before the project I didn’t know about crop rotation. We were planting the same crop in the same field every year but now we know the benefits of crop rotation. Last year I planted sorghum (Macia variety) in my 1.5 acres farm and I got 65 tins. In the previous year 2012 I planted local pearl millet where I got only 30 tins. With crop rotation and good agricultural practices I was able to double the yield.”

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**Keneth Ndalu, Chololo farmer**

**4.2.1.5 Yield increases through adoption of innovations**

The agriculture innovations have been very successful in increasing yields, meaning more household food security and more income from sales of cash crops.

Data gathered by Hombolo Agricultural Research Institute supports farmers testimonies that yields have more than doubled since the project introduced the improved seeds and good
agricultural practices. In the current third season (2013/14), farmers are expecting even greater yield increases. More yield improvement was noted on maize and pearl millet crops than other crops (Figure 1). The reasons for yield improvement in maize is due to proper timing of planting (late December to early January) and use of improved seeds (Stuka and Staha) which are drought resistant, early maturing and high yielding. In addition, farmers in Chololo village cultivate maize in small fertile areas (0.5 to 1 acre) and close to homestead and therefore easy to manage. A combination of the named factors led to increased yield of maize crop. Initially, total crop failure (in dry spell of February to March) was very common mainly due to improper timing of planting dates. On the other hand, pearl millet is highly preferred food crop by the local community due to its drought resistance characteristic. Previously, villagers were using local seed varieties, which were low yielding. Therefore, being assisted by the project through distribution of improved seeds and other good agricultural practices, farmers responded positively and resulted into high yield as noted in figure 1.

A participatory assessment revealed that different farmers have different abilities and resources, broadly categorised as low, medium, and high production. Farmers were asked to report the typical yields for each of these three categories, before and after the project interventions. Their responses clearly showed that the most benefit was noticed among those who had the lowest yields, for example the formerly ‘low’ pearl millet producers are now achieving the same yields as the ‘medium’ farmers previously, while the ‘medium’ farmers are now achieving better yields than the best farmers before.

**Figure 1:** Crop Yields in Kgs per hectare
“Before the project I was farming traditionally. In pearl millet I was getting an average of 2 bags per acre but now I am getting 5-6 bags per acre. In sunflower I am getting 6-7 bags per acre as compared to the past where I was getting 2 bags per acre.”

Stefano Chifaguzi

“Using the education I got in 2012 and 2013 I got enough food for my family and got extra food and cash crops for sale.”

Mary Mpilimi

“With crop rotation and good agricultural practices I was able to double the yield.”

Keneth Ndalu

“The most important good agriculture practices which I won’t forget is using farm yard manure, ox-ploughing, proper planting date, using improved high yielding and drought resistant seeds, planting in spacing and rows, proper weeding, thinning and on-farm rain water harvesting using contours. These agricultural practices made great changes in my farm. The yields have more than doubled. We are now getting extra food for sale, and money for meeting daily expenses and building modern houses.”

James Abel Maligana

4.2.2 Livestock

Unsustainable livestock keeping often has a negative impact on natural resources and crop farming, through overgrazing of common land, compaction of earth, eating crops, and competing for scarce water resources. In this regard, the project aimed to reduce the negative impact on natural resources and develop positive interactions between livestock and arable farming. Oxen are now being used to prepare land for planting, reducing farmers’ workload. Farmyard manure is now being used to help fertilise the soil. Crop residues are being used to feed livestock.

The project has increased the genetic potential of livestock in the village, through the introduction of improved breeds of cattle, goats and chickens. This has increased the productivity of the animals, producing more meat, and more eggs, more quickly. Furthermore, through training, livestock keepers are now more able to keep their livestock healthy, and ensure they have adequate feed, particularly during the dry season.

4.2.2.1 Mwapwa Bulls

There are over 2,000 cattle in Chololo. As in other villages in the region, almost all are traditional Tanzanian Shorthorn Zebu (TSZ) breed. Although this breed has high tolerance to diseases and feed shortage, it has low genetic potential in terms of milk and carcass yield, producing only 1-2 litres of milk per day and reaching age of first mating at 3 - 4 years. Such low production means farmers cannot profit without keeping a large number of animals, increasing pressure on grazing land, resulting in environmental degradation.
The project introduced 30 pure Mpwapwa bulls to improve the genetic potential of the local cattle in the village. The Mpwapwa breed was developed by the National Livestock Research Institute in nearby Mpwapwa, to improve the yields of milk and meat. The crosses (Mpwapwa and TSZ) typically double milk production to 4 liters/day and reduce the age of first mating to 2-3 years as compared to traditional TSZ.

The introduction of Mpwapwa bulls went hand in hand with improvements in disease control (tick-borne diseases and worm infections) and in livestock feeding through preservation of crop residues and hay during the dry season. Introduction and improvement of this intervention will increase household food security and improve livelihood through production of more milk and meat for food and sale.

"I advise other livestock keepers to preserve livestock feed for their animals for use during the dry season and use farm yard manure to increase crop yield."

Gilbert Kasiga, Chololo livestock keeper

4.2.2.2 Leather tanning diversifies livelihoods

Chololo village has about 3,000 goats. The neighbouring village market slaughters 100 goats every month. The skins are sold to ‘middlemen’ at a very low price of about Tshs 2,000 (1 Euro) each.

Leather tanning
The project trained 40 people - men, women and young people - in vegetable leather tanning using Mimosa tree bark extracts. By the end of 14 days training they were able to produce grade one leather. This increases the value of each goatskin tenfold to Tshs 20,000 (10 Euro). 24 of the trainees formed a leather-making group. The group have produced 170 pieces of leather worth Tshs 3.5m (1,700 Euro).

Making leather goods
Production of leather goods such as shoes, belts, key holders, and phone covers can fetch more money than selling leather. Four members of the Chololo leather group were trained for 15 days on making leather goods by SIDO - the Small Scale Industrial Development Organization. A piece of goat leather from Chololo village can produce about 5 pairs of sandals, which sell for Tshs 15,000 (7 Euros) each on average. In this way, one goatskin is transformed into sandals which fetch around Tshs 70,000 (35 Euros). This is over three times the price of one piece of goat leather, or over 30 times the value of a raw goatskin.

These value addition activities strengthen the off-farm rural economy, enabling people to gain skills, making better use of local resources, and bringing more income into the village. In addition, diversifying livelihoods away from rain-fed agriculture (tanning leather and
making leather goods require relatively little water) makes people more resilient to climate change.

“Making leather products has made us self employed. In November, we made 50 pairs of sandals and sold them for Tshs 12,000 to 18,000 each. I advise other rural people to make use of hides and skins to make leather and produce leather goods. This will reduce poverty and help them adapt to climate change.”

Anna Malengo - Chololo community member

4.2.2.3 Blended goat bucks boost productivity and incomes

In Chololo village, the local goat breeds have low growth rates and low milk production potential, reaching 6-13 kg carcass weight and producing only enough milk to feed their offspring. Despite their low genetic potential they need few facilities, are cheap to buy, and have more rapid reproductive rate than the larger herbivores. They adapt to a wide variety of climatic conditions and survive on browse materials not normally consumed by other stock.

Improvement of the genetic potential of the local breeds in Tanzania through crossbreeding has been shown to result in animals (blended goats) that can give reasonable returns for the money spent in raising them. Blended goats have been shown to produce up to 28 kg at 72 weeks, double the weight of local breeds.

Sixty blended goat bucks from Kongwa Pasture Research Centre were handed over to 60 goat keepers (10 from each sub village). The selection criteria were ownership of female goats for mating with blended bucks, and willingness to allow the buck to mate with other female goats owned by neighbours. They attended training on goat management, feeding, breeding, record keeping, housing and disease control.

The goat keepers report increased sales of F1 offspring, with buyers paying around Tshs 50,000, double the price of local breeds, reflecting their increased weights and their value as breeding stock. The improved goats are producing twins, whereas the local breed only produced single offspring. The crossbred goats grow much faster so they can be sold at age 12 months instead of two years, creating more profits for the owners.

“I have benefited a lot from keeping goats and chickens. I have sold goats and got Tshs 550,000. I also sold chicken and got Tshs 250,000. I spent the money I got for paying school fees for my children, investing in farming and business and some for household use. I now have a modern house. My husband has no job and he is totally depending on me. The project has changed me a lot. If I get problems I am able to resolve them myself without depending on my husband.”

Jeri Masianga - livestock keeper
4.2.2.4 Improving local chicken keeping leads to women’s empowerment

The project made a commitment to ensure that women are empowered to act at the forefront of transformation. One way was to identify and develop market sub-sectors of particular benefit to women. Community workshops ranked income-generating activities against criteria assessing both market demand and women’s attitudes: can they do it? Do they like it? Can they keep the money?

Local chicken clearly emerged as the most beneficial sub-sector for women. Interesting insights surfaced; goats and pigs are good business, but the man of the house invariably handles the money, while the money from chicken sales is kept and used by women.

Most Chololo households keep a few local chickens. Local chicken have low genetic potential but are well adapted to the harsh conditions. They grow to 1.5kg and lay only 40 eggs per year. Exotic chicken breeds have high genetic potential in term of meat and eggs production. They can weigh 3 kg - 4kg and can produce over 240 eggs per year. The major disadvantage of the exotic breeds is their inability to withstand diseases and poor nutrition, and so they do not adapt well to the poor rural conditions.

Crossbreeding local hens with exotic cocks combines the adaptive attributes of the indigenous chickens with the high producing abilities of the exotic chicken. Comparative studies found that crossbreds produce 3-4 times more eggs and weigh twice as much (2.5-3 kg) as the local birds.

The project introduced 123 dual-purpose cocks (Barred Rock, Rhode Island Red and White Sussex) for cross breeding with local chicken. The 123 poultry keepers attended training on local chicken management including feeding, rearing, breeding, record keeping, housing and disease control. Ten local chicken vaccinators were also trained, helping to control the devastating Newcastle disease, a major killer.

Most of the people in the village had no poultry house. With the help of a progressive farmer from Kongwa district, poultry keepers from each sub village were trained on poultry house construction using locally available materials, and provided with chicken wire, nails and some feeders. All 123 chicken keepers have started to construct their chicken houses.

Women report increased chicken and egg production, and have been empowered with additional incomes to be able to meet the needs of their families - contributing to better housing, health and education.
“With improved livestock management and disease control, I was able to sell 100 chickens and I got 1,000,000/= (500 Euros). Now I don’t have to beg money from my husband for things like clothing, medicine and school fees. I now have enough money for the household and extra money which is helping me to build our new house.”

Mary Mpilimi - Chololo farmer

4.2.3 Modern beekeeping trebles honey production

Beekeeping is one of the traditional income-generating activities in the village, with over 500 traditional beehives, each producing on average 1.2 litres of honey per year.

The project recognised that the production potential is very low compared to using modern beehives and beekeeping practices. Sixty beekeepers (10 from each sub village) were trained on modern and traditional beekeeping, beehive preparation and installation, management of beehives, bee enemies and their control, beekeeping seasons, beekeeping products, harvest processing, marketing and selling. Sixty modern ‘Tanzanian Top Bar’ beehives were fabricated and handed over to the trained beekeepers. The beehives were hung in the trees within the village forest reserve, and a bait of wax was smeared in each to attract bees.

Two village carpenters were trained on making the modern beehives so that the villagers can buy at lower prices. In the 2012/2013 season only five of the beehives attracted bee colonies, and no honey was harvested, possibly due to poor rainfall and occurrence of bee enemies (Pirate wasp).

The beehives were again cleaned and baited to attract bee colonies for the year 2013/2014. Early reports show that some beekeepers harvested around 5 litres of honey per beehive, over three times as much as their traditional hives. At their best, the modern beehives can produce more than 20 litres of honey per year.

Bees also benefit farmers in other ways. Research shows that four beehives in an acre of sunflowers can increase crop yield by 30% through improved pollination.

“Modern beekeeping provides us more honey than traditional beekeeping”.

Michael Mbumi - Village Chairperson

4.2.4 Fish Farming

Many people think that it is impossible to farm fish in dry and semi-arid areas. However, a visiting progressive farmer from Kongwa District convinced some Chololo farmers that small scale fish farming can work.
He explained how to construct a fishpond and offered to provide fingerlings (small young fish) to help them get started. He showed them how to fertilise the pond with chicken manure and feed the fish with locally available materials.

In the first year four farmers built and stocked fishponds, eventually harvesting adult fish for household consumption, and selling fingerlings to other fish farmers as they also joined in. To date in Chololo there are eleven fishponds, constructed and managed by eleven fish keepers like Agnes Mwalimu.

In Chololo small scale fish farming is a seasonal activity, with farmers filling their ponds during the rainy season when water is plentiful, stocking with fingerlings, harvesting adult fish at around 4 months, then draining their fish ponds during the dry season. Once harvested, the fish keepers are using the water in their fishponds to irrigate trees and for other activities around their homestead. The fish farmers are harvesting fish for home consumption, providing a rich source of protein for their families, and selling surplus fish and fingerlings to their neighbours.

“I got education in fish keeping and made a fishpond, which is supplying fish for my family. I am also using water from the fishpond to irrigate my flowers and papaya trees and seedlings. I am now getting papaya fruits and I am selling seedlings to different people within and outside the village. With water availability, fish can be produced at home and provide food for the household.”

Agnes Mwalimu - Chololo community member

4.2.5 Water

Water is a big problem. When the project began in October 2011, there was no drinking water supply to the village as the borehole equipment had broken down, so people (mostly women and girls) had to walk for two hours a day to get a bucket of water from the next village. When the rains come, the water soon runs away, creating gullies, and causing soil erosion, while the groundwater aquifer is not being recharged. Seasonal rivers fill up during the rains then dry up as the water flows downstream.

The project is tackling these issues through several innovations:
- The village water supply is now powered by solar energy
- The village primary school has been equipped with roof catchment rainwater harvesting equipment, capturing 60,000 litres of water in underground tanks
- A sub surface dam now captures thousands of tons of water in the sandy river bed, providing water for domestic use and livestock through the dry season
- A sand dam captures seasonal rainfall and feeds a hand pump for domestic water supply
4.2.5.1 School roof rainwater harvesting provides 60,000 litres of fresh water

The project constructed a roof catchment rainwater harvesting system at the village primary school. The rain falling on the roof is captured in guttering, and then fed down to underground tanks, via a sand filter. A hand pump lifts the water for drinking, washing clothes, and watering the school tree nursery. The three tanks hold 20,000 litres each, making a total of 60 tons or 3,000 buckets of water. The underground reservoir has a connection to the nearby solar-powered village water supply point, acting as an additional water storage facility later in the dry season once the stored rainwater has been used up.

“The first benefit to the school was from rainwater harvested through roof catchment. The water is enjoyed by the children and the community surrounding the school. Children are getting water all the time for drinking and washing their clothes. Water is also available to irrigate trees and tree nurseries. School children will carry the rainwater harvesting knowledge to their parents and start their own rainwater harvesting.”

Amon Mada - Chololo Primary School Teacher

4.2.5.2 Solar powered village water supply is cheaper and more reliable

When the project started in late 2011, there was no piped water supply in the village. The 40-year-old borehole pump and diesel engine had broken down. People (often women and children) were walking 2 km to the next village to fill their buckets and carry them home on their heads. The project repaired the pump and engine and got the system running again, but the worn out hardware dating from 1971 continued to break down, requiring expensive and time consuming repairs.

The project replaced the old system with an electric submersible pump powered by a solar panel array. The new simple system avoids the use of batteries, with the energy generated by the solar panels directly driving the electric pump. Water is pumped whenever sunshine is available, roughly 12 hours per day. It fills up the village overhead water tank in the morning, releasing water to the community every afternoon.

As the solar energy is essentially free, and very little maintenance is required, the village water committee have reduced the price of water at the village taps by half, and provide free water to older and more vulnerable people. On average, each water point in the six sub villages collects Tshs 2,000 per day making a total of Tshs 12,000 per day for the village. The money collected is used to support the water committee, to pay for a survey for another borehole, and for repair and extension of the piped water system.
“Since the installation of the solar water pump, water is available every day. The price of water has gone down from Tshs 50 in the past to Tshs 25 per bucket. When we were using the diesel pump, there were frequent breakdowns and we were using a lot of money for repairs, and during the repair water was not available.”

Joina Mgohachi - Chololo water committee member

4.2.5.3 Subsurface and Sand dams capture hundreds of tons of rainwater

Seasonal rivers flow during the rainy season, but dry up quickly once the rains stop, as the water flows on downstream. The project has constructed two dams – one in each of Chololo’s two seasonal rivers - to capture the passing rainwater, and store it in the sandy river bed, providing hundreds of tons of water for use during the dry season.

Subsurface dam
First a survey was carried out to determine the best place for a dam, then a trench was excavated (in the dry season) to expose the rocky base of the river. A reinforced concrete wall was built across the riverbed, from the base up to ground surface level, effectively damming the river but without restricting the downstream flow.

During the rainy season, the water continues to flow downstream but a proportion of it is captured behind the dam wall, in the sand. A sump, hand pump, and cattle trough at the side of the river enables villagers to water their livestock or collect water for local irrigation or domestic use. Sub surface dams are considered to be the most reliable water source in arid and semi-arid lands.

Sand dam
The sand dam is a reinforced concrete wall built 2 metres high across the seasonal sand river. During the rainy season, the seasonal river carries soil (composed of sand and silt) downstream. The heavier sand accumulates behind the dam, while the lighter silt is carried downstream.

Within a couple of rainy seasons the dam is completely filled with sand. But up to 40% of the volume of sand behind the dam is actually water, held in the spaces between the sand particles. Because water is stored within sand, it is protected from evaporation, contamination and disease vectors. A two-inch pipe carries the water to a nearby hand pump, for use by the community.

A sand dam can store many thousands of tons of water - recharging groundwater and providing a clean, reliable and local source of water all year round for up to 1,000 people. Sand dams have very low operation and maintenance costs and can last for around 50 years.
4.2.6 Natural Resources

4.2.6.1 Trees help adapt and mitigate climate change

Women walk five hours to collect firewood from the forest, as the trees have been cut down for agriculture, fuel, charcoal and construction. Trees help to stabilize soils, provide shade and protection from the wind. The loss of trees increases soil erosion, wind speed and land degradation.

The project has increased access to natural resources through tree planting, agroforestry, and community land use planning and management, and increased the use of alternative sources of energy.

The project has:

• Trained 133 community members and village leaders on afforestation, nursery management and tree planting;
• Created tree nurseries at the school and several community institutions
• Planted 33,650 tree seedlings (including leuceana, acacia polycanth, neem, mango, guava) at hundreds of households, six churches, the primary school, and the dispensary;
• Planted 3,000 trees in three acres of village forest reserve.

The 2014 end-line survey showed that 86% of respondents reported having planted trees over the past year, compared to 50% in 2011. On average, households each planted 14 trees and 9 of them survived, roughly 65%. Most households obtained seedlings from village tree nurseries (40%), which have increased from only nine percent in 2011. Respondents believe that forest management is important (94%) and almost all respondents (99%) see the necessity to plant trees. Generally, the findings show that there is increased community awareness on tree planting, and that many households have planted trees for various uses.

“The project has enabled the group to start a tree nursery ourselves. In this season we have sold 386 seedlings to Chololo village people. Villages should plant trees and initiate tree nurseries, which will be the source of tree seedlings in the village.”

Asnath Masianga - Tree nursery group member

4.2.6.2 Community land use planning reduces degradation of natural resources

Poor land use management results in the degradation of land, forest and ecosystems as well as generating conflict among different land user groups. In this regard, the village community was strengthened and supported to develop land use plans and bylaws to ensure people use the village land sustainably. They identified areas suitable for crop and livestock production, settlements, woodlands, conservation, beekeeping, and industry in accordance with land policy and land laws.
The work included:

- Educating community members on land policy and laws
- Training village land committees and ward tribunal
- Surveying and mapping the boundaries of village land and acquiring a village land certificate
- Formation and training of District participatory land use planning team and Village land use planning team
- Supporting the preparation of village land use plan and bylaws
- Facilitating registration of village land use plan at district level

“We decided to develop a village land use plan because the village forest has been severely depleted which resulted into massive soil erosion, and sometimes there are conflicts between livestock keepers and farmers. The committee prepared village environmental bylaws and divided the village land into different uses. Now there are areas allocated for agriculture, grazing, settlements, forest, playing ground, livestock routes and roads.”

Yona Sudai - Village environment committee member

4.2.7 Energy

4.2.7.1 Alternative energy reduces deforestation

Tanzania loses around 1% of its forest cover every year. This means around a million acres of forest is cut down annually. Reliance on wood fuel and charcoal for cooking is a key driver of deforestation, as 94% of all (rural and urban) energy consumption is derived from these sources.

Women in the villages of rural Dodoma tell us that 20 years ago there was plenty of wood freely available in the village. But now they have to walk 5-6 hours to collect firewood from the forest.

Deforestation is a driver of global climate change. Forest loss contributes 15 percent of annual global greenhouse gas emissions. Trees absorb greenhouse gases and carbon emissions. They produce oxygen and perpetuate the water cycle by releasing water vapour into the atmosphere. Trees anchor the soil, reducing soil erosion, and help stabilize temperatures, while providing a habitat to 70% of the world’s plants and animals.

The project has supported the community to take up, test, and evaluate a range of alternative energy technologies, including energy saving cooking stoves, and low cost domestic biogas plants. Energy-saving stoves halve the amount of wood needed to cook, reducing pressure on forest resources, saving women time and effort, and reducing harmful smoke such as carbon dioxide etc in the home. In addition, biogas digesters convert
biomass, particularly cattle dung which is readily available and currently little used, into natural gas that can fuel cooking stoves and lamps. A by-product of the biogas digester is a ready-to-use nutrient-rich slurry, a natural soil fertiliser.

4.2.7.2 Energy saving stoves use half as much wood

Typically women in this region cook on three stones over an open fire inside their home. Without chimneys, the homes are smoke-filled leading to respiratory and eye diseases, while the open fire is a dangerous hazard for small children and vulnerable adults.

The project trained 12 women how to construct energy-saving stoves, carried out community sensitization, and provided a subsidy of Tshs 5,000 (€2.50) to cover labour costs. Householders were asked to contribute the needed raw materials: clay, grasses, and water. Around 240 Chololo homes now use the stoves for cooking. The stoves are a local adaptation of the Rocket stove design developed by the German Development Agency GIZ. The main advantages of this stove are that they reduce fuel use, reduce cooking time by having two burners, and evacuate the smoke through a chimney.

A survey of 50 households carried out by the project assessed the impact of the energy saving stoves. The study revealed that using an improved stove cuts down fuel wood use by 57%, reduces household CO₂ emissions by 1.4 tons per year, saves Tshs 85,000 or up to 17 days per year collecting firewood, and reduces the risks associated with firewood collection. The cost of stove construction is only Tshs 5,000 (half the sale price of a local chicken) which can be recouped within 22 days based on the local value of firewood saved.

“You can cook two pots at a time and there is no coughing due to smoke. In the past I was using two bundles of firewood per week on my three-stone traditional stove but now I am using less than one bundle per week with the energy saving stove. This has lessened the burden of fetching firewood, which is now scarce due to deforestation. I advise other women to just get an energy saving stove.”

Mama Chifaguzi - Chololo community member
Figure 2: Household wood consumption (kg/year) by type of stoves

4.2.7.3 Domestic biogas digesters reduce fuel-wood use to zero

Almost half of Chololo households keep cattle, with over 2,000 cattle in the village. The project has introduced 10 domestic biogas plants.

Biogas digesters convert animal dung and other organic materials into combustible biogas. Biogas can be used in simple gas stoves for cooking and in lamps for lighting. The bio-slurry left over from this process is easily collected and can be used as a potent organic fertilizer to improve crop yields. Furthermore, removing the fermented material takes place automatically as the bio slurry is discharged into a compost pit through a channel or pipe. The plant itself, when operated properly needs minimal care.

Farmers with 2-3 cows can generate sufficient gas to meet their daily cooking and lighting needs. This not only saves fuel costs, but also reduces the workload of women and children involved in fuel wood collection. The indoor air pollution associated with cooking on inefficient wood stoves is virtually eliminated with biogas. The fertilizer closes the nutrient cycle, and reduces soil degradation and erosion. In addition, the biogas process is carbon neutral, contributing to the global reduction of greenhouse gas emissions.

The initial cost of a biogas plant is around USD 1,000, but this can be recouped in a few years of reduced fuel costs.
Figure 3: The Biogas plant design

“The biogas is very useful to me. It helps me to cook tea and food quickly in the morning for the people going to graze livestock. Unlike the past, I am no longer going to fetch firewood. There is no smoke during cooking and I don’t destroy the environment.”

Agnes Mwalimu - Livestock keeper

4.2.8 Automatic weather station provides valuable information

The project installed an automatic weather station, gathering data to help farmers adapt to the changing climate. The weather station records temperature, rainfall, humidity, pressure, wind speed and direction. Every 30 minutes the data is transmitted wirelessly to a receiver in the nearby dispensary, then downloaded periodically to a laptop by USB cable as a spreadsheet, enabling charts to be easily created for analysis.

Advances in technology mean that automatic weather stations are now affordable, at around USD 100 each. In Chololo it costed more to construct a fence around it than buying it.

Rainfall varies from village to village, so that existing weather stations at Dodoma and Hombolo can only give a general picture. The village weather station provides valuable information about the local rainfall pattern. The data gathered supports research which shows an erratic start to the rains and the existence of a dry spell lasting several weeks during the rainy season. This information has been used to advise farmers of the best time to plant their seeds, aligning their growing season with the changing rainfall pattern, helping them adapt to climate change to get the best harvest.
4.3 Innovations Assessed By the Village Community

A community workshop assessed the 26 innovations using criteria of effectiveness, gender friendliness, and affordability. The workshop used participatory methods e.g. community matrix ranking to assess the innovations. Altogether 55 participants took part, 60% female.

Effectiveness: Participants were first asked to indicate the effectiveness of each of the innovations, ticking the 4 most effective, using different colour marker pens for men and women.

Women’s benefit: Female participants (only) were then asked to vote by show of hands whether each innovation benefited women, and state why they were of benefit.

Affordability: Participants were asked to indicate whether they would take up each of the innovations: a) not at all, b) only if free, c) only with a loan, or d) with their own money.

Agriculture innovations ranked highly, reflecting the key role farming plays in the village. Women identified improved seeds, intercropping, good agriculture practices, ox-tillage implements, and farmyard manure as most beneficial.

In the livestock session, disease management emerged as a clear and affordable favourite innovation. Improved cocks, while effective and beneficial to women, are only affordable to around half of the farmers. Improved bulls would require major subsidies, while goat bucks would need significant access to loan finance or subsidy.

In natural resources, tree planting is the favourite, most beneficial and affordable innovation. Fuel efficient stoves are also a very popular and affordable choice. Land use planning is seen as effective and beneficial. Take up of agroforestry would be enhanced by a focus on fruit trees. Biogas is seen as a minority option for those with access to loan finance. The results were aggregated to rank the 26 innovations.
The top ten innovations are:

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<tr>
<td>1</td>
<td>Livestock disease management</td>
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<td>2</td>
<td>Improved seeds</td>
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<td>3</td>
<td>Intercropping</td>
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<td>Good Agriculture Practices</td>
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<td>Farm yard manure</td>
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<td>Tree planting</td>
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<td>7</td>
<td>Soil moisture conservation</td>
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<td>Ox-tillage implements</td>
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<td>9</td>
<td>Fuel efficient stoves</td>
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<td>10</td>
<td>Improved cocks</td>
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4.4 Scaling Up – Sharing the Best Practice

The Chololo Ecovillage project has created a working model of good practice. The challenge is how to scale up and share these good innovations with other communities across the region who are also facing the impact of climate change. Therefore, the 6 PE districts present an opportunity for sharing the best practices and innovation learned in Chololo Ecovillage. The key strategies used for sharing the best practices and lessons learned from Chololo Ecovillage include:-

- Policy makers visit Chololo and see the good practices working;
- Farmers field days help to celebrate and share good practice;
- National TV and press coverage is helping to spread the word;
- Chololo farmers tell the story on local radio, encouraging other farmers to try the innovations;
- A Swahili drama and dance group explains the causes and effects of climate change, and encourages tree-planting, good agricultural practices, rainwater harvesting, and the use of alternative energy;
- Students visit Chololo and learn in practice;
- Chololo farmers tell their story to other village communities, and at Nane Nane farmers week;
- The Chololo Ecovillage website is keeping a diary of the project, in words, pictures, sound and video.
4.5 Approaches Used to Implement Chololo Ecovillage Project

The EU funded Chololo Ecovillage project aimed at empowering vulnerable rural communities to adapt and mitigate the impacts of climate change. During implementation, around 25 innovations were introduced in the sectors of agriculture, livestock, energy, water and forestry/natural resources.

The implementing partners facilitated the formation of thematic farmer groups, each based upon a particular set of technologies, e.g. chickens, goats, bulls, ox-drawn tillage, soil moisture conservation, energy saving stoves etc. Membership of the farmer groups included equitable representation from each sub village, and aimed at gender equity. The farmer groups were trained in the technologies relevant to their group, and supported with inputs e.g. provided with improved goat bucks.

A village-level technology transfer management body was set up, made up of representatives from each of the thematic farmer groups, to establish an institutional mechanism for ensuring that community members are able to sustainably take up, experiment, test, and evaluate the wider range of technology options generated by the project.

The project also focused on community and institutional capacity building, to enhance sustainability, increasing community awareness on adaptation to climate change. Key farmers and livestock keepers in the village were selected and trained on climate change adaptation issues. In turn, the key farmers passed on the skills to other farmers in their neighbourhood. This facilitated farmer-to-farmer learning, enhancing and improving the adaptive capacity to climate change.

In the agricultural sector, the key interventions in this sector were training farmers on appropriate cropping systems for improving soil fertility and crop productivity, conservation agriculture innovations, community seed production, soil water conservation innovations, and use of labour saving technology. Other interventions include the improvements and promotion of indigenous in-situ rainwater harvesting, introduction and popularization of best agronomic practices (use of appropriate spacing, soil fertility management and thinning among others), maximizing crop livestock interactions, development of agricultural sub sectors that benefit women, and enhancement of access to markets for agricultural produce through value chain development.

In the livestock sector the interventions focused on genetic improvement and control of diseases of cattle, local goats, and local chickens. In order to improve the genetic potential, Mpwapwa breeding bulls and Blended goat bucks were used to mate with local breeds of the selected female cattle (the Tanzania Short Horn Zebu) and goats to produce improved
offspring with high growth rates, high carcass weight and high milk yield thus contributing to livelihood improvement through sales of milk, cattle, goat and meat. The same was applied to chicken whereby dual purpose (eggs/meat) cock breed for rapid genetic improvement were introduced. In order to control the challenges associated with the introduction of new breeds, local people were trained on management of improved breeds including control of livestock diseases. In addition, the improvement of dry season feeding was implemented by introducing improved pastures and browse species adaptable to semi-arid environment.

The main interventions in forestry and natural resources were community awareness creation on Natural Resources Management (NRM); training community members on afforestation, nursery management and tree planting; establishment of agroforestry, community based forest management, and introduction/rollout of energy saving cooking stoves and trials of low cost biogas plants, and village land use planning.

In the water sector, the intervention focused on rehabilitating the existing borehole and then changing the pumping system from diesel engine / mechanical pump to solar panels / electric submersible pump, hence directly contributing to climate change mitigation by reducing carbon dioxide emissions, while significantly reducing running costs. The intervention also focused on promoting integrated water resources management and rainwater harvesting technology through roof and ground (construction of sand dam and subsurface dam) catchments. The integrated water resources management involved identification of different water users, water facilities and services that were implemented alongside planting of trees in water catchment areas, and community capacity building in water resources management.

4.5.1 Participatory approach in identifying, implementing and evaluation of the project

The Chololo Ecovillage project actively involved the village community in all stages such as project planning (including formulation of adaptation and mitigation strategies), implementation, monitoring and evaluation, and reporting on project progress through the village project committee. The village community was involved through contribution of materials and labour to carry out project activities. The involvement of the village community aimed at securing local community project ownership and enhancing sustainability.

Activities were implemented in very participatory ways and with the collaboration of many actors. For instance, the village committee identified proposals in four key areas of agriculture, livestock, water and forest, which the project implemented. In each sector local people worked hand in hand with the experts for the project success and sustainability. There was moral and material support from villagers to enhance sense of ownership.
4.5.2 Holistic Approach

The holistic nature of the Chololo Ecovillage project makes it unique as it touches every major aspect of rural community life. Agriculture, livestock keeping, water, energy and natural resources are key components of the livelihoods of rural communities in Tanzania, and Chololo village in Dodoma region is no exception. All these sectors are climate dependent, hence increasing the communities’ vulnerability to the impacts of climate change.

Working across agriculture, livestock, water, energy and natural resources, the project touched almost every aspect of people’s lives. This creates buy-in from the community, as people can easily see the benefits; the project responds to all aspects of people's basic needs. Therefore, the holistic approach of Chololo Ecovillage project offered something for every section of the community, and every major livelihood sector, as well as addressing gender issues, reducing women’s workload and promoting women’s economic well being. As emphasized by Heltberg et al (2010), it is important to consider climate change risks and responses in an integrated, multi-sectoral fashion rather that each risk and each sector alone.

4.5.3 Public Private Partnership

In addition, the project is an example of what public – private - partnership (PPP) can do in relation to facilitating local community climate change adaptation and mitigation practices. Some of the partners involved in the implementation of the Chololo Ecovillage project were NGOs namely DONET, MAMADO and TOAM, working alongside public institutions such as IRDP, ARIH and DMC.

Partners agreed their roles and activities with IRDP, met frequently as a project team to coordinate, find and exploit synergies between their actions. Partnership working lends itself well to the use of work packages, clearly defined sets of activities under the responsibility of partner agencies.

In addition, each partner established a clear set of agreed project activities, milestones, and results and reported against these regularly. Team members prepared presentations and shared with broader stakeholders. The project’s organisational structure included the project steering committee, and project technical committee, with regular partner meetings to drive the project, review progress, assess risk, problem-solve, and make changes where necessary. According to Amaru and Chhetri (2013), the inclusion of many actors in dealing with climate change challenges allows for dynamic and flexible problem solving and response to change since they provide resources and expertise to which rural communities do not immediately have access.
4.5.4 **Multi Disciplinary Approach**

The project also has been successful in achieving its objectives due to its multi-disciplinary delivery approach. As noted in the preceding section, the project is implemented by a partnership of IRDP, DONET, MAMADO, ARIH, TOAM and DMC. Therefore each of the partners is responsible for delivering in one or a combination of livelihood aspect according to the areas of speciality while creating an opportunity of complimenting each other technical expertise and operational resources.

<table>
<thead>
<tr>
<th>Sector</th>
<th>Implementing partner</th>
<th>Type of Organisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>Agricultural Research Institute Hombolo. Tanzania Organic Agriculture Movement</td>
<td>Government institution NGO</td>
</tr>
<tr>
<td>Livestock</td>
<td>Institute of Rural Development Planning Dodoma Municipal Council</td>
<td>Higher Learning Institute Local Authority</td>
</tr>
<tr>
<td>Energy</td>
<td>Tanzania Organic Agriculture Movement</td>
<td>NGO</td>
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<tr>
<td>Water</td>
<td>Maji na Maendeleo Dodoma</td>
<td>NGO</td>
</tr>
<tr>
<td>Natural Resource Management</td>
<td>Dodoma Environment Network</td>
<td>NGO</td>
</tr>
</tbody>
</table>

Each project partner specialized in different areas although their work interconnected in various ways, and used appropriately the allocated resources for timely execution of indicated activities. With a partnership of experts in different fields, crossing the divide between public and private / civil society sectors, learning from each other, complementing each other, and breaking new ground in ways of working. The multi-dimensional approach also generated many synergies and feedback loops, recycling benefits and adding value to individual innovations. For example cattle dung is used to generate biogas but also produces fertilizer slurry to improve crop yields. The crop residues are collected and stored for dry season feeding.

4.5.5 **Relevance of the action to the country/region/district**

The project has also been successful due to the fact that it is contributing to the attainment of the National Adaptation Programme of Action (NAPA) and the national climate change strategy. The Chololo Ecovillage project focused on agricultural, water, energy, and forestry sectors, which are the four top ranked sectors according to NAPA. The project also implemented 68 percent of the NAPA’s top 25 ranked project activities and 87 percent of the top five activities in each of the key sectors of agriculture, water, and forestry. Furthermore, the project addressed some of the key issues stipulated in the national climate change strategy. Among the climate change adaptation and mitigation strategic interventions highlighted in the named strategy include the promotion of rainwater harvesting, establishment of woodlots, development and use of energy efficient technologies, use of early maturing and drought tolerant crops, and afforestation and reforestation. The project also embraced the aspect of livelihood diversification by
supporting alternative livelihood initiatives such as beekeeping and fish farming, enhances agro-infrastructure systems (input, output, marketing, storage) alongside promotion of climate change resilient pasture farming and management, and development of land use plan among others.

**4.5.6 Relevance of the action to the beneficiary**

Relationship with the final beneficiaries and target groups is good, particularly with the village community and leadership, which is formalised through a Village Project Committee and less formally through constant communication between project staff and villagers. Villagers were fully involved in implementing project activities. For instance, agriculture activities were implemented in their farms and improved livestock were kept and managed by themselves. They were also involved in energy saving stove construction, tree planting and water development activities.

The action was derived from a Climate Vulnerability and Capacity Analysis (CVCA) participatory research methodology developed by Care International. This was carried out in a series of group sessions with 21 members of the village committee (15 males, 6 females). The activities addressed the key hazards identified by the group, built on the village’s previous experience and analysis of adaptation interventions, and responded directly to their identified suggestions and requests for training and support. The CVCA workshops used participatory research methods to explore community views including historical timelines, seasonal calendars, focus groups of women, farmers, and livestock keepers, hazard mapping, and matrix ranking of the community’s key productive resources against the key hazards they faced from climate related external factors. The matrix ranking exercise clearly identified and prioritised the key climate related threats faced by the communities.

**4.5.7 Project Management and Coordination**

The Chololo Ecovillage management and coordination structure has contributed significantly to its performance. The key features that have rendered the project management and coordination a success include the presence of project leadership (responsible for project coordination) and implementation committees namely the steering committee, technical committee, and village project committee. The steering committee (meeting annually) is a strategic committee responsible for guiding the project, and receiving and approving both physical and financial reports. On the other hand, the technical committee comprising heads of participating partners and village leadership (chairman) meets on quarterly basis to deliberate and verify detailed project partner’s implementation reports covering physical and financial reports. Lastly, the village project committee meeting is responsible for ensuring close connection with the community and resolving emerging issues promptly.
4.5.8  *Flexibility to Innovate and Diversify*

One of the inherent characteristics of the Chololo Ecovillage success was its ability to innovate and diversify in a flexible way. This means that during the execution of the project, the local community and project implementation partners were empowered to innovate and try out new climate change adaptation and mitigation technologies. Likewise, they were also able to diversify their adaptation and mitigation innovations. For instance, some of the activities such as beekeeping, fish farming, and leather making that are currently undertaken by the local community as part of climate change adaptation and mitigation innovations were not part of the targeted activities at the beginning of the project. However, due to their potentials in climate change adaptation and mitigation, such activities are now part and parcel of the project activities.

The three new innovations strongly indicate that community empowerment is vital in enhancing local communities to utilize local resources to diversify from the currently threatened rain dependent agriculture. The flexibility and the urge to diversify is an indication of the fact that adaptation is an ongoing and dynamic process that changes in response to changing socio-economic, technological and resource availability (Amaru and Chhetri, 2013).

4.5.9  *Availability of Resources*

The project has also been successful due to the availability of both financial and human resources. The European Union through the Ministry of Finance and the Vice President’s Office – Division of Environment is very committed to timely disbursement of financial resources for the implementation of various project activities. In addition, the availability of competent and committed project partners enhances smooth implementation of the project. These qualities are further complimented by villagers’ commitment to innovate new technologies to adapt and mitigate climate change impacts following effective capacity building of the village community and their institutions.

4.6  **Lessons That Can Be Leaned and Scaled Up To the Six Project District**

4.6.1  *Lessons learned based on External Evaluation (ex-post) evaluation*

An external (ex-post) evaluation of the Chololo Ecovillage project was carried out by MS-Training Centre for Development Cooperation (MSTCDC). The evaluators’ observations and recommendations are set out below.

4.6.1.1  *On general project design and continuity of benefits*

There is evidence of food surplus in the village but this does not guarantee access for all and good nutrition. Increased food production to enhance access for all, capacity requirements and access to financial or credit facilities are still central to the success of the project. This is
because not all people in the village have taken up promoted technologies and in the manner required. Continued focus on them may still be necessary and required especially if we have to be sure project outputs and outcomes are to be sustained and impacts realized.

**Recommendation:** Systems of dealing more sustainability with technology generation and adaptation, establishment of support/revolving funds in line with existing village community banking, increasing off-farm employment opportunities, and clear linkage, coordination, networking with other district social development mechanisms need to be put in place. Here we are thinking of a working village level on-farm experimentation and technology uptake institutional arrangement with horizontal and vertical linkages to other institutions, organizations and groups for support, spreading out and advancement.

**4.6.1.2 On effectiveness and efficiency of the project**

The project is working through a partnership approach to ensure popular participation; clear understanding of the project/programme logic (key results and indicators); follow up, monitoring, review and feedback systems on assumptions and associated risks. These are important because they are key to the success of climate change adaptation and mitigation projects/programmes. This is because community-based climate change adaptation projects/programmes more often than not rely on a combination of indigenous knowledge and scientific knowledge; scaling up and improving on already existing coping mechanisms; and paying attention to the behaviour of external circumstances and off-site actors.

**Recommendation:** A lot has been done to ensure that project effects are realized through awareness creation, sensitization, training and technical support but we recommend that mechanisms be added to this work which will guarantee a beyond the project success and impact.

An effective climate change adaptation and community empowerment project/programme should include thorough management systems supported by actor MOUs, a good lobbying and advocacy strategy(ies), and capacity building strategy(ies) that address the three needs of empowerment, that is: enhancing people’s power through greater confidence in one’s ability to successfully undertake some form of action related to climate change adaptation; increasing people’s relations with organizations, partners and institutions dealing with climate change adaptation; and increasing people’s access to economic resources, such as credit and inputs which will reduce vulnerability and enhance achievement climate change adaptation livelihood outcomes especially for women and the poorest in the community.

**4.6.1.3 On the impact of the project**

The project puts a lot of emphasis on the harvesting and proper use of available water. This is good because communities like Chololo will for a long time in the foreseeable future
depend on rain-fed agriculture even with its vulnerability to climate change. This is due to their level of on-farm infrastructure development and the inherent social, economic, and institutional weaknesses in the way they do things. There are three water needs that dominate the lives of the Chololo villagers; for domestic use, for livestock use, and for crops. Managing and satisfying these water needs will contribute to continued use of project outputs, outcomes and greater impact of the project.

**Recommendation:** probably their best bet in staying ahead of climate change is to enhance their capacities in harvesting available water in ways that improve their water use efficiency; storing enough water to bridge the gap between seasons; putting in place land resource planning systems that are flexible; use of several cultivars of the same crop with differing maturing periods to capture moisture fluctuations during the season; using produce drying and storage systems that can address seasons of plentiful and scarce rains plus the attendant changes in disease infections and pest populations; and practicing systems that enhance livestock and crop interactions; vegetation growth especially within homestead and water catchment areas; and integrated soil and water conservation.

4.6.1.4 **On project/programme outputs and outcomes sustainability**

The time given for communities to think through, plan for and establish key structures/institutions for effective project implementation, monitoring, review and feedback is critical in ensuring ownership and sustainability. Equally critical and related is the existence of a flexible exit strategy from the beginning that is continuously updated as the project/programme progresses. We feel that the lead period provided for at the beginning of the project should have included the formulation of a good exit strategy so as to guarantee sustainability.

**Recommendation:** A lead period to prepare and engage communities fully before the start of climate change adaptation work is important to understand and internalize project/programme logic, link it to what normally happens in day-to-day life and smoothen the flow of ideas and information as implementation takes place. An exit strategy taking care of the following should be developed before getting too involved with promoting change

(a) Aligning project strategy and value to stakeholder goals and welfare, especially the community, and Dodoma Municipal Council;
(b) Discounting for and effectively managing risks to enhance desirable future outcomes;
(c) Analyzing demands of future commitments, benefits, and variety of alternative use of project investments and facilities by the community and Dodoma Municipal Council;
(d) The degree to which the project enhances the benefits and usefulness of some of the present engagements of the community and Dodoma Municipal Council;
(e) Taking into consideration the economic value added to people’s livelihoods by the outputs of the project;
(f) Not compromising information and knowledge management to fit certain pre-conceived ideas of project designers;
(g) Strong integration of project costs and benefits into stakeholder expenditure budgets;
(h) Strong monitoring and comparison of project actual performance vis-à-vis the planned performance, ensuring sources of discrepancy and the need for caution is well captured; and
(i) Working more to ensure there are systems in place that will manage and supervise all the infrastructure (water pumps, dams, to ensure they are sustained beyond project schedule.

4.6.1.5 On visibility approach to collaboration, cooperation and networking

A good visibility approach exists in the project. This should be one of the outputs that need to be sustained. This is because the multiplicity of actors, the variety of interests and influences related to climate change adaptation and mitigation work, the variant levels of interaction and the need for an inter-sectoral and inter-disciplinary approach mean that an active visibility component to the work is necessary. This will help attract attention, build support and pool together like-minded people and organizations in order to exploit capacities and synergies.

Recommendation: we recommend the continuation of the visibility approach targeted at getting support clientele, focus development partner attention; draw actors towards our interventions, and relate interventions to current issues and development trends is critical. All forms of social, electronic, print and audio-visual media should be skilfully put in place to support climate change adaptation and mitigation work for faster impact.

4.6.1.6 On building institutional capacity and linking with resources beyond project time

The project steering committee and partners are doing a good job and for this to go on beyond the project time, an effective institutional arrangement should be put in place to ensure the work continues and the necessary values and attitudes are sustained. This is because climate change adaptation and mitigation work is value-laden undertaking and requires that proper institutions and institutional behaviour (best practices) are identified, in-built and properly linked to other development work taking place around us so as to ensure continuity, impact and sustainability.

Recommendation: Local institutions are central to success of any development work at the grassroots. District and national institutions are necessary for success of any development work at these levels. There is need to develop institutions at each of these levels and link
them properly for effective coordination, collaboration and cooperation. Agricultural/rural extension services need to be bolstered and revamped to show individual farmers the benefit of improved farming techniques and other innovations.

There is an urgent need to develop value chain for the selected crops and livestock products to ensure existence of Chololo Ecovillage brands. This will bring more value addition to the communities. There is a need to establish an effective knowledge and information management system (KMS) which could ensure that information is disseminated to target small scale farmers on timely basis.

Effective linkages are important especially to effectively manage the technology triangle: technology generation; technology dissemination; and technology use; in order to derive maximum benefits from technologies being promoted.

### 4.6.2 Other lessons learned from Chololo Ecovillage Project

Other lessons learned from Chololo Ecovillage project in relation to community adaptation and mitigation practices include:-

- The efforts to address climate change in particular through community adaptation and mitigation practices should take a holistic approach whereby the focus should encompass all livelihood sources, sectors, and community groups rather than focusing on single or just few issues. To that end partnership among local actors should be embraced for the purposes of sharing and complimenting resources, knowledge and experiences;

- Some innovations to address climate change that are effective, gender focused and affordable can easily be implemented using local resources and institutions. For instance, innovations such as livestock diseases management, local production and use of improved seeds, intercropping, good agricultural practices, use of farm yard manure, tree planting, soil moisture conservation, use of fuel efficient stoves among others are innovation with high contribution to adaptation and mitigation practices but yet they are also easily applicable to a wide range of local community members. However, effective extension services are needed in order to create awareness to the local community on the use of such locally available, effective and affordable innovations;

- Effective engagement of community members including capacity building to their local institutions is critical for successful implementation of various innovations to address climate change challenges. In addition, community involvement and capacity building are critical sustainability ingredients for community adaptation and mitigation initiatives and
• Some innovations in empowering local communities to adapt and mitigate climate change are capital intensive. As noted in Chololo Ecovillage, innovations such as community seed production, forest management, beekeeping, leather making, biogas, improved bulls, goat bucks, land use planning, sand/subsurface dam, fish farming, water resource management, and roof catchment water harvesting are capital intensive especially during the initial stages for community take up. In this regard, resources availability is critical in realizing intervention objectives.

4.7 Challenges and Barriers that Chololo Ecovillage Project Encountered

4.7.1 Institutional Challenges

Start date delayed: The first challenge happened before the project started, and was caused by delays at the level of the funder/contracting authority in assessing and processing the project proposals and agreements needed to get the three successful projects underway. This meant that instead of starting in July 2011, the project start was delayed until Sept / Oct 2011. This meant that the project had only one or two months available to prepare the farmers in advance of the rain season.

The solution was found by reviewing the project work plan so as to identify and prioritise those activities that are rain-dependent, and put non rain-dependent activities on hold for a few months. Also the project partners agreed to use their existing resources to get the project underway, rather than wait another month until the first tranche of project funding was released. This meant that the project was able to avoid losing the first year of rains, a crucial benefit in a 26 month project.

Partnership working: The project was delivered by a partnership of six agencies from both public and civil society sectors, including a higher learning institute, three NGOs, an agricultural research institute, and a local authority. While this had significant benefits in terms of multi disciplinary, multi sectoral approaches, it also brought complexity, with different organisational styles, abilities, and ways of working.

The partners shared a strong commitment to the success of this project and worked flexibly and with mutual respect to accommodate the differences in organisational structure and culture, in pursuit of the common goal. Wherever there were challenges partners meet, discuss and resolve the challenge without conflict. The external evaluation report suggested that formal MOUs and agreements between partners would also be useful.

4.7.2 Agriculture

Seed supply was an issue, as Tanzania generally has a major shortfall in supply of improved seeds, and serious problems of fake seeds in the market. However as one of the project
delivery partners is a government agricultural research institute, we had extensive knowledge of and preferential access to the limited supply of seeds both in the market place and through public sector agencies.

**Push-pull technology** was planned to be introduced – as an integrated pest management technique. This technique, developed in Kenya, involves intercropping Silver leaf Desmodium, a fodder legume, with maize, Napier and Sudan grass to provide both immediate and long-term benefits. Aromas produced by the Desmodium repel (push) pests like the maize stem borer while scents produced by the grasses attract (pull) the stem borer moths and encourage them to lay eggs in the grass instead of in the maize.

The plan was not implemented, largely due to unfamiliarity with the recently developed concept and difficulty in acquiring the relevant germplasm.

### 4.7.3 Livestock

**Mpwapwa bulls** were introduced to improve the genetic potential of the cattle in the village. However in order to reduce costs, young immature bulls were purchased, which were not able to inseminate the local cattle until late in the project. Thus the benefits of the genetic improvement were not clearly visible until after the end of the project.

**Pasture** planted in 2011/12 rain season did not perform well due to prolonged dry spell lasting 42 days. The performance of planted pasture in 2012/13 rain season was once again not good because of poor germination of the seeds and difficult in controlling livestock which invaded the area during the dry season. In the rain season of 2013/2014 we distributed the seeds to individual farmers who planted the seeds in contours and encouraged them to harvest the seeds and plant them in future in their farms.

Chololo village had no land use planning and therefore there was no specific area for grazing especially during the dry season, therefore in 2013/2014 we developed a Participatory Land Use Plan with Environmental Conservation Bylaws which, if well implemented and enforced, we expect will improve the situation.

### 4.7.4 Water

A **Hand pump** constructed to extract water from the subsurface dam was destroyed by the power of the water at the start of the rains. This was due to poor sitting of the pump.

The problem was resolved by re-sitting the hand pump to a safer location at the side of the river.
Rainwater harvesting infrastructure at the river and school took longer than expected to be completed and was not fully operational until the second rain season/second year of the project.

This could be resolved by more realistic planning of the timescales for larger infrastructure projects, e.g. sand dams and subsurface dams.

Resistance to change to solar energy: At first the pump attendants resisted the new solar powered water supply technology and complained to the village water committee that the new pump was not suitable for the village. MAMADO made investigation and discovered that the complaint was nothing more than seeking to continue getting free diesel on weekly basis.

Animation was done to village government, village water committee and pump attendants for the wellbeing of borehole and the community at large. It was clearly explained that the solar pump was effective and efficient. In addition, animation was conducted up to village assembly again clearly explaining that solar pump was suitable for the village, that no money for fuel would be required.

4.7.5 Energy

Adoption of energy saving stoves was slow at first as residents were familiar and comfortable with their three-stone stoves, and reluctant to change to a new technology, and a new way of preparing food for the family. In Year 1 it was difficult to find residents willing to change from their traditional three stones to the improved stoves. The messages about the benefits of the energy saving stoves were not taken on board until a certain critical mass of stoves generated enough interest among women in the village.

However now that around 240 stoves are in use there has been a shift of attitude and uptake, as more householders, particularly women, have come to understand and internalise the benefits: being able to cook using two pots at once, less smoke in the home, safer environment for children, and significant reduction in fuel use, meaning that women now only need to go to the forest – a five hour round trip - to collect wood one a week instead of twice.

Domesic biogas digesters installed were very successful in terms of providing gas for cooking and lighting, and reducing fuel wood use to zero in those households. However the cost of construction was heavily subsidised and it is unlikely that residents in poor villages will be willing or able to invest in this technology with ongoing subsidy.
4.7.6  Natural Resources

Tree planting survival rates: The main challenge on survival of tree species is limited community support on watering the planted trees especially during the dry season. It was observed that tree survival rates were lower in the community forest than in community households. Watering of trees close to homesteads depends on water from the domestic water points pumped from the village borehole, and the owners of the trees recognise the direct benefit they get from the trees. Trees planted in the community forest are far from homesteads and from the domestic water points, requiring much more effort caring and watering, while the community members involved see much less direct benefit to themselves. Also livestock frequently invaded the community forest during the dry season when there was shortage of pastures.

To mitigate the challenge, more intensive monitoring was undertaken by DONET staff to encourage the community to provide support and management. This intervention has improved community participation and ownership of the project.

Land use planning process encountered a challenge during the village mapping process, a boundary dispute between Chololo and the neighbouring village was identified. This needed to be resolved before the land use planning process could be continued, which caused delay.

The land conflict was resolved through discussions mediated by village leaders, enabling the land use planning process to be concluded.

4.8  How Gender Was Mainstreamed In the Chololo Ecovillage Project

The Chololo Ecovillage project was implemented by 6 partners which includes, Institute of Rural Development planning, Agriculture Research Institute – Hombolo, Maji na Maendeleo Dodoma, Dodoma Environmental Network and Dodoma Municipal Council. During initial planning to implementation of Chololo Ecovillage project the project had 13 staffs. Among these staff 7 were males and 6 were females. The balance of gender was almost 50%. This was done purposely to make sure all aspects involving women and men are considered during the project planning process.

The project proposal guidelines required a study on Climate Change Vulnerability and Capacity Analysis (CVCA) in order to identify the most vulnerable village. In doing this study, the project involved people of all categories in the respective villages. These included men, women, youths, old people, religion people, traditional village leaders and government village leaders. This enabled us to get information from all groups, which enabled us to plan relevant adaptation and mitigation strategies against climate change. The study provided
useful information about the roles and workloads of women, for example that women typically walked five hours to and from the forest to collect firewood for cooking, and had to walk for another two hours to collect drinking water from the neighbouring village.

The project was also informed by a recent survey carried out in the village by TOAM, one of the Chololo delivery partners, to explore gender issues, including the gender ownership and control of resources, and the gender division of labour. The survey found that women typically have less ownership and control of resources, but do more work than men. The answers varied with men and women giving different answers, particularly about the division of labour, with each claiming to do more work than the other. Typically women do 2.5 hours more work per day than men, and even more in the case of female headed households where women typically work over 12 hours per day. This imbalance in the division of labour relates to the concept of women’s triple role (productive, reproductive, and community managing) as opposed to men’s single ‘productive’ role. Women also have to look after the household (children, food preparation, water and firewood collection) as well as doing farm work, while men mainly concentrate on farm activity, and take rest when not farming.

During implementation of the project, gender was considered in all aspects in the sectors of agriculture, livestock, water, energy and forestry. One of the project’s specific objectives was to empower women to act at the forefront of transformation, with increased authority and reduced workload. For example during sensitization of the project 107 farmers attended, 72 were females and 35 were males. In Chololo village large livestock such as cattle are mainly owned by men. Therefore during livestock distribution gender was considered, out of 30 improved bulls distributed in Chololo 29 bulls went to males and only 1 went to female. For improved goat bucks, 45 bucks went to men and 45 went to women. Chicken in Chololo village are mostly owned by females. Because of this out of 123 improved cocks distributed, 71 went to females and 52 went to men. Cooking is also mostly done by women and therefore more women were involved in using energy saving stoves. Biogas plants were given to male headed households who had livestock (cattle) and who can partially pay the cost of installation.

**Gender Based Value Chain Development**

Using a value chain approach developed by OXFAM, a leading international non-governmental development organization, the Chololo Ecovillage project carried out a study to develop effective and innovative market development interventions in subsectors / market chains of particular benefit to women. The first task was to identify and select subsectors of most benefit to women.
Sub Sector Selection
The team held a series of four participatory workshops over three days with 192 members of the village community (including 105 women). The first workshops prepared a list of all known subsectors of income generating activity. This provided the starting point for the sub sector selection. In each workshop the list was verified, added to, and narrowed down to around ten subsectors of specific interest and benefit to women.

These shortlisted subsectors were then scored out of ten by participants against a series of five criteria, two assessing the market, and three assessing women’s participation.

Criteria 1: Market demand
- Proven demand for commodity;
- Demand outstrips supply

Criteria 2: Women’s participation
- Wide adaptability and applicability for women;
- Women respond positively to the activity;
- Women could have control of revenue from sales of the commodity.

The workshops were filled with hard work, heated discussion, and much laughter. In some cases participants were asked to ‘vote’ by shouting out ‘NDIYO’ to show their approval of each activity, and the volume of raised voices provided a good indicator of the score. Interesting insights emerged. It turned out that although goats and pigs were good business activities, because the amount of money received at point of sale was so substantial, the man of the house usually handled the money. While in the case of chicken, the smaller amount of money is held and used by women.

The resulting scores were added up and fed back to the participants. In every workshop group Local Chicken clearly emerged as the most beneficial subsector for women. Other high scoring subsectors also involved livestock, including dairy cattle, goats, and pigs, while sunflower, groundnuts and sesame trailed as the leading field crops. Tailoring emerged as the highest scoring non-agriculture related subsector.
Sub Sector / Value Chain Analysis

The team then analyzed the local-chicken sub sector through a series of meetings with chicken subsector stakeholders including Dodoma Municipal Council Agriculture & Livestock Department, Rural Livelihood Development Company, INADES, restaurant buyers, Institute of Rural Development Planning, and Mpwapwa Livestock Research Institute. In each meeting the discussion focused on understanding the chicken production system and value chain, and identifying constraints and opportunities.

Constraints included:

- Diseases: Newcastle, Gombolo, Fowl Pox
- Hatching losses thru non-fertilisation
- Chick deaths >50% thru predators/accidents
- Long time to maturity (6 - 7 months)
- Lack of housing limits flock size
- Shortage of feed limits flock size
- Market fluctuations (Tsh 3000-8000)

Opportunities identified:

- Trained community vaccinators
- Improved cocks
• Feed is available locally
• Extension officer in place
• Community members are keen
• Feed is very expensive but many ingredients are already available
• Eggs from local chicken are good price in Dodoma
• Direct sales to restaurants get Tsh 8,000 each

Programme Design
A workshop was held with key service providers to feed back the findings and to develop a cohesive programme of interventions needed to exploit the opportunities identified, as well as address the constraints, in the local-chicken sub sector. These include interventions aimed at:

• Supporting farmers to move closer to semi-intensive methods
• Production improvements to shorten time to maturity from 6 months to 3-4 months
• Disease control thru improved access to vaccination
• Better chicken housing and protection
• Improved feeding
• Collective marketing for better prices

Project partners and service providers used these findings to inform plans to deliver / mainstream these interventions to help empower women of Chololo Ecovillage to develop chicken keeping as a way to raise rural incomes and take a lead in strengthening the community through enterprise development.

The committees formed in the village included both man and women of all ages and sometime in some committees such as natural resource committee had more women than men. Also during baseline and endline survey the proportion of men to women respondents was almost fifty-fifty. Harnessing oxen in agriculture work reduced the farm work load to both men and women. The endline survey showed that women had benefited economically better than men from their involvement in the project, increasing their average annual income 64% from Tshs 341,389 to Tshs 560,344 within 32 months of the project, while men’s average incomes increased 14% from Tshs 637,254 to Tshs 729,055.
Figure 4: Both men and women participating in project activities

The project document itself had a specific objective on empowering women (disadvantaged group) to act at the forefront of the transformation, with increased authority and reduced workload. Specifically the project aimed at ensuring that women occupy 50% of the positions of leadership of village committees and groups, reducing women’s workload by 50%, and supporting 100 women to generate increased incomes through improved chicken farming, plus identifying and developing other value chains of benefit to women.

Women’s workload was reduced through a number of labour saving strategies, freeing up women’s time to be used on more productive activities. The use of ox-drawn implements (ox-ploughs, ox-ridgers, and magoye rippers) in land preparation has reduced women’s workload, as initially women were using a lot of energy and time in preparing the land for planting using hand-hoes. Women are now using Energy Saving Stoves which use 50% less firewood than the traditional three-stone stoves which they were using before. Currently, women’s workload for fetching firewood has decreased by 50% as women who now use the new stoves only need to collect firewood once a week instead of twice. For those women using biogas, the workload on firewood fetching has been reduced even more.

Workload for fetching water for women and children has been reduced as the solar powered village water supply is no longer subject to constant breakdown of the former diesel engine and water pump. Before the project the diesel engine could work for 2 weeks in a month. The 2 weeks of the month was for the repair of the engine. During the repair of the engine women and children were walking long distance (>1 km) to fetch water. To date the village is using a solar pump which pumps water to domestic water points throughout the year and therefore women and children get water closer to their homestead where they use less energy and time in water collection.

Through the increased income from sale of goats and chickens, and increased female involvement in leadership and membership of village committees, women are now having more authority in the village community, and in their access to and control of household resources.

Jerry Masianga says “I have benefited a lot from keeping goats and chickens. I have sold goats and got 550,000/= I sold chicken and got 250,000/= I spent the money I got for paying school fees for my children, investing in farming and business and some for household use. I now have a modern house. My husband has no job and he is totally depending on me. The project has changed me a lot. If I get problems I am able to resolve them myself without depending on my husband”
5.0 GUIDELINE TO SUPPORT IMPLEMENTATION OF P-E OBJECTIVES IN SIX SELECTED DISTRICTS

5.1 Introduction

The analysis of the current situation in the 6 PE districts has highlighted key challenges in the areas of environment, agriculture, climate change, livestock, energy and gender among others. Experience from Chololo Ecovillage has shown successes in interventions implemented in empowering vulnerable rural communities to adapt and mitigate the impacts of climate change. Based on Chololo Ecovillage experience, various lessons are drawn to help in supporting other villages across the country to take up climate change adaptation and mitigation technologies in agriculture, livestock, water, energy, and natural resources. In view of this, the 6 PE districts can benefit from the lessons learned from Chololo Ecovillage. This section therefore presents the guideline (general and specific) to guide scaling up of the best practices learned from Chololo Ecovillage to the 6 PE districts.

5.2 General Guideline

- Select and form a multidisciplinary team for implementing the project drawn from government and non-government sectors;

- Carry out participatory climate vulnerability and capacity analysis using PRA/CVCA methodology in at least three wards within the district;

- Select representative location and target group for pilot project implementation;

- Carry out institutional analysis of the target group / area so as to identify key community organisations to build on;

- Select a suite of most effective, affordable and gender friendly innovations to be introduced;

- Establish village technology transfer committee that will work in partnership with Local Government Authorities (LGAs) and relevant financial service providers to mobilize a revolving loan fund for community take up of capital intensive technologies or innovations;

- Carry out a study to identify and select sub-sectors of most benefit to women for developing effective and innovative market development interventions;
• Ensure that gender issues are integrated in all aspects of the project (planning, implementation, monitoring and evaluation);

• Select and design appropriate farmer training methodology/ies (e.g. Farmer Field Schools (FFS), Farmer Family Learning Groups (FFLG), Farmer to farmer extension, demo plots etc.);

• Develop a set of key objectives, results and indicators, work plan, etc;

• Involve and sensitize the local authority and community on the project activities, managing expectations;

• Conduct baseline survey to benchmark socio-economic status;

• Form monitoring and evaluation teams comprising all stakeholders (Village project committee, Technical project committee and Steering committee);

• Conduct midterm internal evaluation of the project;

• Conduct end line survey to monitor project success;

• Conduct final external evaluation of the project and

• Conduct workshop at closure of the project for sharing learning with external stakeholders.

5.3 Specific Guideline

5.3.1 Agriculture – Crop production

• Selection of farmers to work with the project;
• Conduct training on Good Agricultural Practices including Climate Smart Agriculture, post harvest storage, marketing and value addition;
• Supply appropriate agriculture inputs (e.g. improved OPV seeds) and farm implements;
• On farm supervision of selected farmers;
• Collect data on crop growth, performance and yield;
• Connect farmers to potential markets;
• Assist farmers on building storage structures;
• Assist farmers on building structures for rain water harvesting, ground water utilization and lake/river water for irrigation;
• Assist farmers on appropriate practice for horticultural crops.
5.3.2 **Livestock production**

- Select livestock keepers from each village and sub-village;
- Conduct training on improved livestock management, disease control, feeding and preservation of crop residues and hay for dry season feeding;
- Identify sources and suitable improved livestock breeds for upgrading the genetic potential of local breeds;
- Assist livestock keepers on disease control;
- Provision of improved breeds for genetic improvement of local livestock;
- Assist livestock keepers on livestock infrastructures such as dips and watering points;
- Supervision on implementation of the livestock activities;
- Collect data such as crossbred offsprings, and livestock sales for monitoring success.

5.3.3 **Natural resources**

- Selection of village community that will be involved in tree planting using seedlings and Farmer Managed Natural Regeneration (FMNR);
- Training of village community on conservation of natural resources including tree planting and Farmer Managed Natural Regeneration;
- Formation of tree nursery groups for nursery establishment;
- Facilitate the supply of appropriate tree seeds/seedlings;
- Identification of area/s for tree nursery establishment;
- Nursery establishment;
- Identification of areas for tree planting and FMNR;
- Supervision of the afforestation activities;
- Formation/strengthen village Natural Resource Committee for monitoring and enforcement of environmental bylaws.

5.3.4 **Energy**

5.3.4.1 **Popularizing Energy Saving Stoves (ESS)**

- Sensitive households (mostly women) on the benefits of using energy saving stoves;
- Selection and training of women and men on construction of ESS;
- Setting criteria for supporting adoption of ESS;
- Construction of ESS to individual households;
- Collect data on fuel wood saved, time saved, distance saved, health issue, regeneration of trees and reduction of greenhouse gas emitted.
5.3.4.2 Popularizing biogas energy

- Sensitize households involved in livestock keeping on benefits of using biogas for environmental management among other benefits;
- Selection and training of women and men on construction and use of biogas digesters;
- Setting criteria for supporting adoption of biogas;
- Construction of biogas digester to individual households;
- Collect data on fuel wood saved, time saved, distance saved, health issue, regeneration of trees and reduction greenhouse gas emitted.

5.3.4.3 Popularizing solar energy

- Sensitive households and local institutions such as schools and hospital on the benefits of using solar energy;
- Select and train few community members especially youths on installation and maintenance of solar energy systems;
- Setting criteria for supporting adoption of solar energy;
- Installation of solar energy systems to individual household and institutions ready for adoption of solar energy;
- Data collection on kerosene or diesel saved for determination of green house gas emission and money saved, increase in working hours, reading hours for school pupils.

5.3.5 Water

- Create awareness through community training on water status within the village and the impacts of climate change on water supply;
- Formation and strengthening of water user committee;
- Promotion of rain water harvesting through roof catchment and surface runoff;
- Construction of subsurface dam and sand dams;
- Promotion of underground water harvesting;
- Promotion of integrated water resource management;
- Supervision of water activities;
- Data collection on water availability, water supply, decline of waterborne diseases, time and distance saved etc.

5.3.6 Development of Village Land Use Plan

- Educating community members on land policy and land laws;
- Facilitating formation and training of village land committees and ward tribunal;
• Facilitating survey and demarcation of boundaries of village land and acquisition of a certificate of village land;
• Formation and training of District Participatory Land Use Planning Team and Village Land Use Planning Team;
• Supporting collection of technical data for preparation of village land use plan and preparation of land use plan bylaws;
• Facilitating registration of village land use plan at district level;
• The guidelines for Participatory Village Land Use Management in Tanzania of (1998) can be used to develop the Village land use plans.

5.3.7 Integration of Poverty, Environment, climate change management and gender into district development plans.

• Capacity building in poverty, environment, climate change management and gender to district and village authorities;
• Review existing DDP to determine the level of integration of Poverty, Environment, Climate change and Gender;
• Workshops involving key stakeholders such as councilors, heads of relevant departments and implementers for awareness on the importance of mainstreaming poverty strategies, environment, climate change adaptation and mitigation strategies and gender in DDP;
• Support village leaders / ward councilors to convene village meetings to gather priorities for poverty reduction, environmental conservation, climate change adaptation and mitigation, and gender issues to be included into District Development Plans.

5.3.8 Multiplier Effects

This activity is important for scaling up innovations in the project areas to other areas within and outside the six PE districts. The following activities are important for scaling up to other areas.

• Farmer Field Learning;
• Study visits;
• Formation of technology transfer fund / access to finance for investment in climate change technologies;
• User friendly publications;
• Mass dissemination of technologies through National and Local Media and internet and video.
5.3.9 **Sustainability Assurance**

- Continuous collaboration and empowerment of local community members including village leaders and management;
- Partnership with local district council;
- Community understanding and ownership of the benefits of the project;
- Mainstreaming of Poverty, Environment Climate change and Gender in District Development Plan will assure continuity of the project activities and benefit after the phase out of the project;
- Existence and enforcement of Village Land Use Plan and Environmental bylaws will ensure the continuity of project activities.
6.0 CONCLUSIONS

Based on the findings presented in this report, the problems and needs in environment, agriculture, livestock, beekeeping, energy and fisheries in the 6 PE districts are in many respects similar to those of Chololo village prior to the implementation of the Ecovillage project. Perhaps the main difference is that some of the PE districts (Nyasa, Bunda, Bukoba and Sengerema) have unique natural resources through their proximity to lakes, which present additional opportunities for climate change adaptation. In addition, the 6 PE districts are also experiencing gender inequalities and absence/poor enforcement of environmental bylaws, mirroring the challenges experienced in Chololo.

Experience from the activities implemented in Chololo Ecovillage on environment, agriculture, livestock, water, energy and natural resources have shown commendable improvement such as improved crop and livestock productivity, improved water availability, and increased use of biogas and energy saving stoves. The use of biogas and energy saving stoves has reduced the dependency on, and the amount of, firewood used as a main source of household energy. This will eventually improve forest regeneration and environmental quality (reduce pollution especially carbon dioxide and methane). Furthermore, the implementation of various activities in Chololo Ecovillage has shown improvement in food security, income and water availability. The major success factors for such changes include use of holistic approach, community participation, gender consideration, and public private partnership among others. Despite the successes noted in Chololo Ecovillage, there were some challenges and barriers (institutional and sector specific) to project implementation, which were resolved. Similar experience can be replicated in other districts facing similar challenges so as to improve the quality of the environment, and the livelihoods and resilience of the communities.

The guidelines developed are based on the experience of Chololo Ecovillage project with consideration of the unique differences existing across 6 PE districts such as the existence of Lake Victoria and Nyasa. It is worth noting that challenges will inevitably exist during implementation of PE projects, hence the need for flexibility in finding appropriate solutions for achieving the intended goals.
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