Proceeding of the National Workshop on
Integrated Watershed Management
on Gibe - Omo Basin
Jimma University and Gilgel Gibe Site
PROCEEDING OF THE NATIONAL WORKSHOP IN INTEGRATED WATERSHED MANAGEMENT ON GIBE - OMO BASIN
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NATIONAL WORKSHOP IN INTEGRATED
WATERSHED MANAGEMENT
ON GIBE - Omo Basin

JIMMA UNIVERSITY and Gilgel Gibe Site
23-25 DECEMBER 2010, ETHIOPIA

Jimma University (JU)
Heinrich Boll Foundation (HBF)
Sustainable Land Use Forum (SLUF)
Ethiopian Electric Power Corporation (EEPCo)
Population, Health and Environment (PHE) Ethiopia Consortium

Prepared by:
Jimma University
PHE Ethiopia Consortium
Organizers of the workshop

**PHE Ethiopia Consortium (PHE)** is a non-profit making local NGO that provides coordination and capacity-building to 48 member organizations and actively involves in communication, networking, research, advocacy and capacity building. PHE Ethiopia Consortium has a holistic, participatory development approach whereby issues of environment, health and population are addressed in an integrated manner for improved livelihoods and sustainable well being of people and ecosystem.

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**Jimma University (JU)** is a public higher educational institution established in December 1999 by the amalgamation of Jimma College of Agriculture (founded in 1952) and Jimma Institute of Health Sciences (established in 1983). JU is Ethiopia’s first innovative Community Oriented Education Institution of higher learning.

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**Sustainable Land Use Forum (SLUF)** is a local NGO established in 1995 as a network engaged in Natural Resource Protection and Sustainable Land Management. Currently in accordance with the Charities and Societies Proclamation no. 621/2009 SLUF has been registered as an Ethiopian Residents Charities Consortium with certificate no. 0523 on November 2009. Ethiopian Evangelical Church Mekane Eyesus Building, 5th Floor

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Preface

Dams provide multifaceted purposes to the socio-economic development of a nation through irrigation in agriculture and generation of hydro-electric power in the supply of energy. It is a bold fact that the hydro-electric power generated using dams are environmentally friendly and introduced clean and green technologies to the nation. Ethiopia is undertaking a huge project on construction of dams for the purpose of electric power generation and integrated irrigation development. However, due to environmental phenomenal happening and persistent human action in the country our dams are facing problems in relation to siltation, landslides and degradation and nutrient accumulation.

Considering the growing problem and a need to create awareness among different stakeholders, a workshop was organized in Integrated Watershed Management on Gilgel Gibe-I dam, where participants are gathered from the government, non-government organizations, academia, member organization and partners. The participants discussed on the matters concerning siltation, landslides and degradation and finally reached on consensus to establish national task force that would work in integrated watershed management on the Gibe - Omo Basin.

PHE Ethiopia Consortium would like to appreciate and thank its participants who attended the workshop and contributed their idea and view on the issues raised during the workshop.

It is also the interest of PHE Ethiopia Consortium to work with government bodies on the issues of policy and decision making in the area of social, economic and environmental issues. Similarly, our consortium is interested to work with academia in the area of research and with other civil society organizations in partnership in the aforementioned areas of concern to contribute for the success of the country's GTP & MDG.

Negash Teklu
Executive Director, PHE Ethiopia Consortium
Acknowledgements

PHE Ethiopia Consortium would like to extend a special thanks to Ethiopian Electric Power Corporation for their relentless effort for the successful completion of the workshop. Many thanks would also be extended to Henrich Boll Foundation and Jimma University for their contribution at different capacity. All government offices and non-government organizations would also be appreciated for their inexorable contribution during and after the workshop. The Consortium would also acknowledge all those who take part in the workshop and contributed their precious ideas either presenting their paper or actively reacting for the purpose of the successful outcome of the workshop.

Finally, PHE would like to thank all those who support the workshop in material, moral and financially.
### Acronyms and abbreviations

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>AF</td>
<td>Agro-forestry</td>
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<tr>
<td>Al</td>
<td>Aluminum</td>
</tr>
<tr>
<td>BBC</td>
<td>British Broadcasting Corporation</td>
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<tr>
<td>BNF</td>
<td>Biological Nitrogen Fixation</td>
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<td>Ca</td>
<td>Calcium</td>
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<tr>
<td>CBE</td>
<td>Community Based Education</td>
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<td>CBTP</td>
<td>Community Based Training Program</td>
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<td>CDC</td>
<td>Center for Disease Control</td>
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<td>CDM</td>
<td>Clean Development Mechanism</td>
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<td>CO₂</td>
<td>Carbon dioxide</td>
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<tr>
<td>CSO</td>
<td>Civil Society Organization</td>
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<tr>
<td>D/TTP</td>
<td>Development/Team Training Program</td>
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<tr>
<td>EEPCo</td>
<td>Ethiopian Electric Power Corporation</td>
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<tr>
<td>EIA</td>
<td>Environmental Impact Assessment</td>
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<tr>
<td>ERA</td>
<td>Ethiopian Road Authority</td>
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<tr>
<td>ESIA</td>
<td>Environmental and Social Impact Assessment</td>
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<td>EPA</td>
<td>Environmental Protection Authority</td>
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<td>FAO</td>
<td>Food and Agriculture Organization</td>
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<td>FDRE</td>
<td>Federal Democratic Republic of Ethiopia</td>
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<tr>
<td>Fe</td>
<td>Iron</td>
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<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
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<tr>
<td>GG</td>
<td>Gilgel Gibe</td>
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<tr>
<td>GG II</td>
<td>Gilgel Gibe Two</td>
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<td>GGIII</td>
<td>Gilgel Gibe Three</td>
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<tr>
<td>GG HEP</td>
<td>Gilgel Gibe Hydro electric power</td>
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<tr>
<td>GIS</td>
<td>Geographic Information System</td>
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<tr>
<td>GOs</td>
<td>Government Organizations</td>
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<td>GTP</td>
<td>Growth and Transformation Plan</td>
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<td>GWh</td>
<td>Giga Watt per Hour</td>
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<tr>
<td>GPS</td>
<td>Geographical Positioning System</td>
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<tr>
<td>HBF</td>
<td>Heinrich Boll Foundation</td>
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<tr>
<td>H.E.</td>
<td>His Excellency</td>
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<tr>
<td>HEP</td>
<td>Hydro Electric Power</td>
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<tr>
<td>ICT</td>
<td>Information Communication Technology</td>
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<tr>
<td>IWM</td>
<td>Integrated Watershed Management</td>
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<tr>
<td>IUC</td>
<td>Institutional University Cooperation</td>
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<tr>
<td>IBC</td>
<td>Institute of Biodiversity Conservation</td>
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<tr>
<td>IBS</td>
<td>Integrated Bio-economy System</td>
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<td>ICS</td>
<td>Interconnected System</td>
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<td>IHIS</td>
<td>Institute of Health Science Research</td>
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<td>JU</td>
<td>Jimma University</td>
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<tr>
<td>K</td>
<td>Potassium</td>
</tr>
<tr>
<td>kg ha⁻¹</td>
<td>Kilogram per hectare</td>
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<tr>
<td>kg ha⁻¹ yr⁻¹</td>
<td>Kilogram per hectare per year</td>
</tr>
<tr>
<td>Km</td>
<td>Kilo meter</td>
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<tr>
<td>km²</td>
<td>Kilometre Square</td>
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<tr>
<td>kWh</td>
<td>Kilo watt per hour</td>
</tr>
<tr>
<td>LS</td>
<td>Livestock</td>
</tr>
<tr>
<td>LULCC</td>
<td>Land Use Land Covers Change</td>
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<tr>
<td>m²</td>
<td>Meter Square</td>
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<tr>
<td>m.a.s.l.</td>
<td>meter above sea level</td>
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<tr>
<td>MDGs</td>
<td>Millennium Development Goals</td>
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<tr>
<td>Mg</td>
<td>Magnesium</td>
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<tr>
<td>Mn</td>
<td>Manganese</td>
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<tr>
<td>mm</td>
<td>Millimeter</td>
</tr>
<tr>
<td>mm³ /year</td>
<td>Millimeter cube per year</td>
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<tr>
<td>mm³/year</td>
<td>Millimeter per year per minute</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Description</td>
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</tr>
<tr>
<td>MoFED</td>
<td>Ministry of Finance and Economic Development</td>
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<tr>
<td>MOA</td>
<td>Ministry of Agriculture</td>
</tr>
<tr>
<td>MoFED</td>
<td>Ministry of Finance and Economic Development</td>
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<tr>
<td>MoWE</td>
<td>Ministry of Water and Energy</td>
</tr>
<tr>
<td>MW</td>
<td>Mega watt</td>
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<tr>
<td>N</td>
<td>Nitrogen</td>
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<td>NAMA</td>
<td>National Adaptation Mitigation Action</td>
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<tr>
<td>NGO</td>
<td>Non-Governmental Organization</td>
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<tr>
<td>OFWE</td>
<td>Oromia Forest and Wildlife Enterprise</td>
</tr>
<tr>
<td>REDD+</td>
<td>Reducing Emission from Deforestation and Forest Degradation</td>
</tr>
<tr>
<td>RF</td>
<td>Rainfall</td>
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<tr>
<td>SIDA</td>
<td>Swedish International Development Agency</td>
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<td>SLUF</td>
<td>Sustainable Land Use Forum</td>
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<tr>
<td>SLM</td>
<td>Sustainable Land use management</td>
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<tr>
<td>SSY</td>
<td>Suspended Sediment Yield</td>
</tr>
<tr>
<td>SNNPR</td>
<td>Southern nations Nationalities People Region</td>
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<tr>
<td>TB/HIV</td>
<td>tuberculosis /Human Immune Virus</td>
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<tr>
<td>t ha−1 year−1</td>
<td>ton per hectar per year</td>
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<tr>
<td>Topo</td>
<td>Topography</td>
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<tr>
<td>TOR</td>
<td>Terms of Reference</td>
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<tr>
<td>TV</td>
<td>Television</td>
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<tr>
<td>P</td>
<td>Phosphorous</td>
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<tr>
<td>PHE</td>
<td>Population, Health and Environment</td>
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<tr>
<td>PRA</td>
<td>Participatory Rural appraisal</td>
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<tr>
<td>PSU</td>
<td>Program Support Unit</td>
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<tr>
<td>Ppm</td>
<td>part per million</td>
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<tr>
<td>USD</td>
<td>United State Dollar</td>
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<tr>
<td>VS</td>
<td>Vetiver System</td>
</tr>
<tr>
<td>VLIIR</td>
<td>Vlamse Interuniversiteit Raad (Flemish Inter University Cooperation)</td>
</tr>
<tr>
<td>VS</td>
<td>Vetiver System</td>
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<tr>
<td>°C</td>
<td>degree celicious</td>
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<td>Zn</td>
<td>Zinc</td>
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<td>WB</td>
<td>World Bank</td>
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Executive Summary

The huge dams of Ethiopia, the existing and the new ones, are under threat of several impacts such as siltation problem has been one of the factors affecting the life span of the different hydroelectric power structures. Based on the evidence obtained from the research result from Jimma University, pressing need has been arised to involve several stakeholders to partake in a consultation and collaboration workshop. Beginning on December 23, 2010, a three day National Workshop on Integrated Watershed Management on Gilgel Gibe-I was held at Jimma University in the Southwest part of Ethiopia with around 150 participants. The workshop was aimed at improving the intricate and multifaceted problems of siltation and landslides surrounding the Gilgel Gibe dam. The workshop was attended by ministers, government officials, representatives of non-government organizations, academia, researchers and both government and private media. The workshop was organized collaboratively by Population, Health and Environment (PHE) Ethiopia Consortium, Jimma University, Ethiopian Electric Power Corporation (EEPCo), Heinrich Boll Foundation (HBF), and the Sustainable Land Use Forum (SLUF). The sponsors of the workshop were EEPCo, Jimma University, HBF and PHE Ethiopia Consortium.

A welcoming address was made by Dr. Fikire Lemessa, President of Jimma University, who remarked on the need for sustainable land use management to address the issue of siltation in Gilgel Gibe I dam. Then, Negash Teklu, Executive Director of PHE Ethiopia Consortium, presented the importance and introductory remarks about the National Workshop on Integrated Watershed Management on Gilgel Gibe I dam and its contribution to outcomes that will be implemented in the watershed area of the dam. After that, Corporate Planning Director of EEPCO, Mekuria Lema, acknowledged that various stakeholders should work together with EEPCO to at least minimize the problem and enhance the lifespan of, not only Gilgel Gibe I dam, but also other existing and new dams in the country. His Excellency, Kebede Gerba, State Minister of Water and Energy, gave the opening speech. The minister emphasized that water and rivers of the country are the main planning unit of the government for future economic growth and development, and that they need proper sustained management and utilization strategies to increase their efficiency and effectiveness.

After the welcoming & opening ceremony, a book exhibition was displayed to participants of the workshop by Jimma University, PHE Ethiopia Consortium, SLUF and HBF and was visited by the participants.

Details about the impact of siltation and the associated causes of landslides and degradation on Gilgel Gibe-I dam was presented by researchers from Jimma Univesity. These presentations were moderated by H.E Kebede Gerba, State Minister of Water and Energy and Dr. Fikire Lemessa. The presentations stressed the need for action as the siltation problem is prevalent near and around the catchments area of Gilgel Gibe-I dam. After their presentations various questions were raised by attendants and debated by presenters of the workshop.

The following day, the workshop was moderated by Dr. Tewoldebirhan G/Egziabher, Director of EPA and H.E. Sleshi Getahun, State Minister of MoA. The workshop started with a presentation by Mekuria Lema, briefing about Gilgel Gibe-I dam and its structural capability and feasibility regarding problems of siltation. Following, other possible environmental conservation technique were presented by Vetiver Network about vetiver grass and its rationale for use in terms of environmental protection. Then, the need for integration of social, economic and ecological capital to address environment and development issues was presented by Bio-Economy Africa. The role of Oromia Forest and Wildlife Enterprise (OFWE) in terms of environmental protection in the entire region and particularly for the catchment area of Gilgel Gibe was presented by which then followed by questions and deliberations.

The afternoon session, moderated by Negash Teklu, Dr. Habtemariam Abate, Kora Tushune, Mekuria Lema, and Mesfin Kassa, was devoted to group discussions. The groups independently discussed issues on policy, development, research, funding and donors and implementation, and came up with pertinent outcomes which would help to solve the problem of siltation in Gilgel Gibe.

The discussion was important in order to delineate the way forward and to make recommendations which will be implemented as a solution to the problem. As a result, a National Task Force for the Gilgel - Omo Basin was established by the participants of the workshop which will be lead by the Ministry of Water and Energy. The task force has members from MoA, MoH, MoFED, MoE, SNNP, Oromia, CSO (represented by PHE Ethiopia Consortium) and donor (represented) by World Bank.

The workshop was concluded by a field visit to Gilgel Gibe-I dam, the power plant and the vetiver grass multiplication site in the dam area.
A week later, PHE organized a discussion forum on the continuation of success at a dinner ceremony in Addis Ababa, with organizing committees that created an environment conducive to exchanging reflections, views and ideas on the long run implementation plans for protecting the dam.
Scope & objective of the Workshop

Allleviating these complex and multifaceted problems surrounding the Gilgel Gibe dam, however, is not a task that can be left to one or just few institutions. Rather, it calls for a holistic approach where all concerned parties and stakeholders working in the area should work together in a well coordinated and organized manner. The solutions required should, therefore, be multifaceted as are the problems and should consider the wide range of interventions that fall within a basin in an integrated watershed management framework.

It was with this major purpose and central theme that the current national workshop on Integrated Watershed Management on Gilgel Gibe I was organized through joint efforts of PHE Ethiopia Consortium, EEPCO, Jimma University, Heinrich Boll Foundation and SLUF. The workshop has brought several stakeholders, key government ministries, universities, NGOs, GOs, CSOs, local representatives, various networks and interest groups. The first part of the workshop focused on the problems related with the Gilgel Gibe I dam. The next part emphasized on some of the interventions and research efforts underway in a bid to minimize the harmful impacts of all the problems faced by the dam. Finally, discussions were held in groups with the aim of coming up with practical solutions, recommendations and the way forward. Poster displays, publications and technology exhibitions, and field excursions were also part of the three-day workshop.

Objective of the Workshop

General Objective:

The main objectives of the workshop is to understand the current climatic change, geo-hazards (siltation, sediments) and human anthropogenic activities towards the Gilgel Gibe I Dam and to take initiatives and take corrective measures through integrated watershed management approaches together with all stakeholders to sustain the intended economic life span of hydro electric power generation.

Specific objectives:

- To create awareness about the problem facing the Gilgel Gibe dam
- To identify the current research needs and initiatives to mitigate the impacts of geo hazards on Gilgel Gibe I dam.
- To form responsible national forum to bring together relevant stakeholders for coordinated responses of current threatening conditions through integrated watershed management approaches.
- To document an ongoing and potential research promoting the protection and challenges faced the Dam and local communities through action research.
- To scale up the possible and best practice interventions to all new and constructed dams in Ethiopia
Ethiopia has huge potentials of natural resources that are not yet fully exploited. The country is endowed with diverse natural resources and biodiversity which offer enormous opportunities. Its population size, with due investment on education and health, could also be converted into huge human resource and wide market at the same time. On the other hand, Ethiopia is experiencing rapid population growth and severe environmental degradation, which have resulted in widespread poverty and chronic food insecurity. Moreover, increased fragmentation and marginality of land with growing global climate change have made poverty eradication difficult and more challenging. Climate change will have wide-ranging effects on the environment, socio-economic and related sectors, including water resources, agriculture and food security, human health, terrestrial ecosystem, biodiversity and Coastal zones.

However, Ethiopia has made unprecedented commitment to improve the livelihood of its nation, with the vision to advance the country to middle income countries within a short period of time. This calls for a great leadership to end destitution and break the cycle of poverty across generations. To this end, the government has made huge investments and expansions in infrastructure development during the last fifteen years. It is investing on power, telecom, and health services etc.

Expansion of power system and energy is central to transform the development. Per capita consumption of electricity is only 7% of the sub-Saharan average, despite the capacity to produce up to 45,000 MW from power generation mix. It is undeniable that the power is crucial for economic development. Peak demand and sales on the interconnected systems shot greater than 25% from 2009 onwards by industry, commercial and domestic customers.

However, so far the utilization of this potential is limited to 2,000MW which is less than 4.5% of the existing potentials. Currently, access to electricity in Ethiopia is only about 35% and only 5,189 towns and villages out of 7,000 are electrified. In Ethiopia, the average per capita energy consumption is about 36kWh while the minimum average level of consumption per capita for reasonable quality of life is about 500kWh. This corresponds to an annual electricity consumption of 46,344GWh based on current population (EEPCo, 2010).

Hydropower generation is the major source of energy in this future plan, accounting about 95% of the total power generations. The midterm expansion plan to 2015 contains mainly hydropower plants thus increasing the hydropower share to nearly 100%. Nonetheless, dependence on such a predominantly hydropower system has its own potential negative consequences in terms its vulnerability to impacts of climatic changes, geo-hazards, and manmade adversities like deforestation other anthropogenic activities. This might challenge the economic life span of hydraulic structures of the hydro power plant like dams.

As effective development and management of hydropower is central to the quest for sustainable development and meaning full economic growth to the country’s industrial and agricultural development however, there are risks related to change in climatic conditions and geo hazards which might influence its expected benefits.

The current global warming is expected to accentuate climate extremes such as droughts, floods and temperature. This change will have a direct impact on power production from hydropower plants. Output from hydropower plants will be more variable and uncertain than in the past due to high evaporation from the reservoirs and change in the amount of rainfall (HBF, 2009).

A degraded local environment also increases the cost of hydraulic structures and reduces their useful life span. Vegetation losses and consequent soil erosion makes dams to silt up much faster, leading to situations of below optimal production of power than planned. Sediment accumulation and outlet hampers proper operation of dams and also causes reservoirs to submerge more are with consequent lose in land use, biodiversity and social impact (Buzayehu, 2006).

1. According to Ethiopian statistical agency Eth. Population is approximated to 73,918,505(CSA 2007 census), CIA 85,237,338(world fact book Ethiopia,2010)
2. (Definition) “when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life”(World Food Summit,1996)
3. Ethiopian electric power corporation, Gilge Gibe III hydro electric power Environmental and social impact assessment
4. EPRDF ,Growth and transformation plan,2010
Gilgel Gibe-I is one of the huge hydropower plant constructed by SALINI COSTRUTTORI, an Italian company, in 2006 with estimated power generation of 722 million KWh annually.

Figure1: Gilgel Gibe I Dam

Change in climatic condition resulting in huge form of flooding and raise in evaporations, Geo hazard problems like landslides, gullies and siltation are some of the anticipated challenges and environmental problems threatening the long benefits of the dam.

Figure2: Photo Show Gibe River

According to a study done on the assessment of siltation and nutrient enrichment of Gibe dam, it was found that siltation and nutrient enrichment were the major problems in this reservoir. (Devi et al, 2007).

Human anthropogenic activities like the burning of coal, deforestations and various agricultural activities like change in land use, mismanagement of land, grazing may also alter the composition of atmosphere contributing to climatic change. Previously, the EEPCo has made resettlement compensation for 10,000 people displaced from the perimeter of the Gilgel Gibe I reservoir. Moreover, quick growing plant species which are suitable for existing agro ecological condition of the project were planted around the perimeter of 500m² buffer zone. However, due to lack of attention and proper follow-up the buffer zone couldn’t serve its purpose as the displaced communities went back to their original place. Weak protective measures and poor management are to blame for this failure to sustain the buffer zone. Farmers are now carrying out normal agricultural activities within the buffer zone.

5. Caused by humans: anthropogenic degradation of the environment
In addition to this, river bank erosion during flash floods and events of landslides in the up-stream of Gilgel Gibe River and its tributaries are important sources of suspended sediments, which get into the reservoir of Gilgel Gibe I hydroelectric plant. Such phenomena pose major threats to the economic use and life span of the dam. Unless corrective measures are taken to alleviate these threats, it won't be long before this important power plant goes out of use. To this end, different parties have been raising their concerns over the danger facing Gilgel Gibe I dam at different times. Prompted by such concerns, several stakeholders have been involved in one way or another with the dam, each looking at the problems from its own perspective and hence trying to address them in its own way, with little or no effort to bring synergy and coordination among the actions of all the different actors. Moreover, efforts to promote community participation and involvement have been very minimal. Consequently, most of the interventions carried out have not been successful.

Integrated Watershed Management (IWM) is more a philosophy of comprehensive integrated approach to natural resources management. It aims at integration of social resources management with natural resource management. The approach is generally preventive, progressive, corrective and curative. Watershed management involves the judicious use of natural resource with active participation of institutions, organizations, in harmony with the ecosystem. The approaches also being developed as part of a strategy to achieve food security while protecting the environment through sustainable land use development, integrated watershed management (IWM) approaches being developed. The major advantages of IWM approaches are involvement of those most affected by the decisions (i.e. the stakeholders) in all phases of the development of their watershed and holistic planning that addresses issues which extend across subject matter disciplines (biophysical, social, and economic sciences) and administrative boundaries (village, woreda etc) (Reid et al, 2003).
Components of Watershed Management

The three main components in watershed management are land management, water management and biomass management.

Land Management

Land characteristics like terrain, slope, and formation, depth, texture, moisture, and infiltration rate and soil capability are the major determinants of land management activities in a watershed. The broad category of land management interventions can be as follows: Structural Measures, Vegetative Measures, Production Measures, and Protection Measures.

Mechanical conservation measures may become necessary in watershed management in the initial stages. Structural measure include interventions like contour bunds, stone bunds, earthen bunds, graded bunds, compartmental bunds, contour terrace walls, contour trenches, bench terracing, broad based terraces, centripetal terraces, field bunds, channel walls, stream bank stabilization, check dams etc. Watersheds may contain natural ecosystems like grasslands, wetlands, mangroves, marshes, water bodies. All these ecosystems have a specific role in nature. Vegetative measures include vegetative cover, plant cover, mulching, vegetative hedges, grass land management, vetiver\textsuperscript{6} fencing, agro-forestry, etc.

The production measures include interventions aimed at increasing the productivity of land like mixed cropping, strip cropping, cover cropping, crop rotations, cultivation of shrubs and herbs, contour cultivation conservation tillage, land leveling, use of improved variety of seeds, horticulture, etc. Protective measures like landslide control, gully plugging, runoff collection, etc can also be adopted. Adoption of all the interventions mentioned above should be done strictly in accordance with the characteristics of the land taken for management.

Water Management

Water characteristics like inflows (precipitation, surface water inflow, ground water inflow) water use (evaporation, transpiration, irrigation, drinking water) outflows (surface water outflow, ground water out flow) storage (surface storage, ground water storage, root zone storage) are the principal factors to be taken care of in sustainable water management. The broad interventions for water management are listed below;

- Rain Water Harvesting, Ground Water Recharge, Maintenance of Water Balance, Preventing Water Pollution and Economic use of water,

Biomass management

Major intervention areas for biomass management are indicated below;


Most of the intervention areas have been touched during the three days workshop with special focus on their role and implications for the management of Gilgel Gibe I dam watershed.

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\textsuperscript{6.} Tropical grass (chrysopogon zizanioides, previously vetiveria zizanioides)
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Summary of presentations

The Sustainable Use of Soil Resources of Gilgel Gibe Dam Catchment

Degradation of renewable natural resources such as land, water and forests have been a serious causes of low productivity of land and which in turn threaten the ability of most Ethiopians to meet their basic needs. Food insecurity has been a challenge and a major barrier to development in Ethiopia. Despite a strong potential for increased agricultural productivity, South-western Ethiopia is environmentally challenged, mainly due to deforestation and hence soil erosion and nutrient depletions, have profound effect on this region. Among such land resources of great economic importance for the country is the Gilgel Gibe catchment which provides water for the Gilgel Gibe hydroelectric power plant (the largest hydro electric power dam in the country). The 4225 km² catchment is occupied and cultivated by large number of smallholding farmers. However, poor land management practices coupled with the rugged topography, erosive rainfall regime in the area and nutrient depletions pose major threats both to the livelihood of the farmers and the life span of the dam. The study has assessed the soil degradation, sediment transport and soil and water conservation measures and to assess of the soil characteristics and the spatial distribution of soils in the Gilgel Gibe watershed.

The research argued that the on-site consequence of biophysical resource degradation is increasing sediment deposition in the reservoir of Gilgel-Gibe hydroelectric power plant; agricultural production has been constrained by the continuous biophysical resource degradation in the catchment among which decline in soil fertility and deforestation were the major ones. Frequent incidences of landslides were also other forms of resource degradation observed that seriously influence people's livelihood in the catchment. Water lodging is the other problems in these vertic planosols. Further studies are going on to understand their genesis, properties, distribution and proper utilization.

Rainfall-runoff Dynamics, Sediment Source and Yield in Gilgel Gibe catchment

Soil erosion is a serious problem in Ethiopian highland areas that increased sedimentation of reservoirs and lakes. Sediment export rates in the Ethiopian highlands are characterized by important changes in sediment supply. It important to study, the key sources of sediment; causes of both natural and management related sediment production and source; quantify the magnitude of sediment delivery of Gilgel Gibe watershed. The research investigated the rainfall-runoff relationship of the catchment using historical records of the river discharge and rainfall; to found out where the sediments come from in the landscape through an exploratory study; explored more insight in the extent, causes and consequences of landslides in the catchment, and attributed to a better insight in the contribution of the landslides to a sediment load in the rivers and finally to estimate the relative contribution of the sub-catchments to the suspended sediment entering the reservoir.

In line with the study, the total soil loss into the rivers from landslide is estimated as 11 t / ha/ yr for the last 20 years, therefore, landslides need to be point out as an important sediment source for rivers in the Gilgel Gibe catchment. There is high variation among catchments in SSY due to the variation in the catchments characteristics in the Gilgel Gibe catchment. Gilgel Gibe has the lowest SSY (0.43 t/ha/yr) and Unta has the larges SSY (132.08 t/ha/yr).

The research is recommending for the integrated management of the watershed of Gilgel Gibe water catchment. Therefore, there should be management of buffer zone through involving the community around the dam from planning to monitoring and evaluation stage, and make these community beneficiaries of the buffer zone.

Gilgel Gibe Hydro Electric Power Plant

The Gilgel Gibe River, which stretches for about 176 km from its sources, is the major tributary of Great Gibe River. The Gilgel Gibe Power plant is constructed on this river by the Ethiopian Electric Power Corporation as part of the country’s general development plan with the aim of expanding the electric power generation capacity of the country. The plant with a capacity of 184 MW increased the installed capacity of the national grid by 25%. The erosion process of the Gilgel Gibe catchments and its sedimentation impact on the hydroelectric power dam was evaluated and analyzed by EEPCo before the construction was undergone. According to the result, the solids flow in the reservoir and the calculation to determine the dead capacity of the dam was made in order to guarantee
the power plant a useful lifespan of at least 50 years. Three different types of data were available for evaluation of solid flow, and a comparison was made in order to estimate a reliable field of variables for the measurements. Direct measurements of sediment transport on the Gilgel Gibe carried out by ENEL/ELC association in May 1996 in correspondence to the dam section with a flow of 25 m3/s. The sediment content has been found to be 0.255 g/l and divided as follows: sand 5%; Silt 23%; clay 22%; colloids 50%. The concentration of solid content is exponentially proportional to the liquid flow of the river. In the reservoir the ratio between reservoir capacity and average annual inflow is about 0.45. The trap efficiency is therefore about 80% according to Churchill and about 95% according to Brune. An annual average silt weight comprised between 3.4 and 4.0 Mt may be considered; An annual average silt weight comprised between 3.4 and 4.0 Mt may be considered as the specific weight of the sediment is generally 1.2 -1.3 t/m3 the extreme annual silt volumes are as follows: vmin = 2.8 mm3/year vmax= 3.4 mm3/year.

Having this info consideration, EEPCo determined the life span of the dam to be 50 years while integrated watershed management of the catchments of Gilgel Gibe is properly done its life span may extends to 70 years. For this EEPCO is doing its best level in conservation and watershed management of the catchments.

**Vetiver System Application for Climate Resilient Eco system**

Land degradation, which is a result of land use and land cover changes, is one of the major environmental problems facing Ethiopia. It is also one of the major causes of climate change and climate alteration in the country. Various techniques have been proposed to sustain this environmental problem at various levels. However, it always demands simpler techniques to uphold the problem. Sustainable Land Use Forum (SLUF) supported by SIDA brings the experience of vetiver grass to the problem of land degradation. This paper presented the practical experience of SLUF/SIDA project on vetiver grass. The paper pointed out that vetiver grass application helps not only to solve environmental problems such as land degradation and land slide but also its application for climate resilience ecosystem. The 20 years experience of vetiver grass application in various parts of Ethiopia implies that the country have a better experience of the vetiver and its contribution in poverty reduction and better sustainable environment including climate change adaptation and mitigation.

The paper pointed out the special characteristics of the vetiver grass such as its growth nature under extreme and wide range conditions; the temperature, rainfall, soil and PH conditions suitable for its growth; and its non-competitive and non-invasive nature among others. Its application ranges from small scale farm for the conservation of water and soil to a high level road construction and rehabilitating mining areas in different parts of the world. Besides its environmental protection role, the vetiver grass can be used for construction of household utensils. All this make the grass to have multi-purpose application.

**Integrated bio- economy system for sustainable watershed management**

The presentation focus such as population pressure, human health and education, land scarcity, shortage of water, energy, and infrastructure problems, which altogether challenges the livelihood of local people. The integrated bio-economy system (IBS) spotlight the three dimensions such as the social, economic and ecological ones need to work together to resolve and minimize the challenges facing the human society. In doing so, the presentation emphasis on the relevance of the integration of the three in bringing sustainable development at every level be it local, or national. The IBS works by scaling-up and scaling-out the best practices of its projects in different parts of Ethiopia. In this regard, the IBS projects in Addis Ababa, Benishangul Gumize-Assosa, Tigray Region-Mekele, and Oromyia Region- Assela can be sited as an example.

These best practices in different parts of the country can be taken as experiences to be applied in watershed management of the Gilgel Gibe Catchment where it needs the integration of the social, economic and ecological dimension of the area.

**Forests and Environmental Services**

Oromia accounts for 70% of the highland forest cover of Ethiopia. The need to reverse the prevailing alarming rate of deforestation; the need to promote forestry as competent land use option; and the need to enhance the contribution of the forestry sector for the socio-economic development are some of the burning issues of the
forest resources of the region. In line with the issues the objective of the OFWE includes

- to conserve the existing forest resources by involving local communities living in and around the forests;
- to develop new forests to increase the forest cover of the region;
- to sustainably utilize the forest resources to fulfil the demand for forest products (includes replacing imported wood and exporting some products) and;
- to contribute to the economic development of the region and Country.

The presentation therefore argued for the need for woody plant cover, which occupies 1/3 of the land surface accomplishes almost ½ of the world’s annual photosynthetic fixation of carbon. On the contrary deforestation contributes to 20% of the total carbon emission. Therefore, to enhance the contribution of forests in climate change mitigation, increase the forest cover by planting new trees; reduce deforestation is a must at all levels.

**IUC Partnership Program Collaborative Research Activities in Gilgel Gibe catchment**

IUC partner program is the university development cooperation program that is run under VLIR by VLIR-UOS. VLIR is an interuniversity council of higher education institutions in Flanders, Belgium, established in 1976. It receives the funds from DGDC; manages university development cooperation funds on behalf of member institutions. The key features includes is Long-term, based on priority areas of partner university; Phase-in, phase-out and consolidation strategies; Fostering collaboration and matchmaking (not traditional aid?); comprehensive in its support and mobilization of expertise; promotion of networking (NS, SS and NSSC); and distinctive management structure.

The IUC support various research programs both at undergraduate and graduate levels and works in staff capacity building programs. The IUC focus on research agenda should be defined through active participation of the stakeholders; researchers, policy makers and practitioners should work together to bridge the prevailing gap between research and policy; higher education institutions should be active players in the development agenda and assume more responsibility in the issues of population, health and environment.
Discussions with presenters

(Moderators: H.E. Kebede Gerba and Dr Fikre Lemessa)

Q1: From the presentations you showed us that the Gilgel Gibe Hydropower dam is in the verge of collapse because of siltation. But if mitigation measures are taken how much can we reduce the risk of siltation to increase the life span of the dam?

A1: If we take mitigation measures against soil erosion and landslides, we can reduce the risk of siltation and definitely increase the life span of the dam.

Q2: The report of Devi et al, 2008 you cited claims that the dam will be filled up with silt in 24 years time has some methodological problems. They used only one model and some of the measurements they indicated, for example that of phosphorus is very much exaggerated. Is your data supporting this claim?

A2: I know that the report has some methodological problems. They considered only data of one season. But it shows us that it needs urgent action to sustain the dam so that it can serve for the intended time. To get complete picture of the magnitude of the problem we are using six monitoring stations and data of several seasons. As the study is in progress we can't give actual figures but the trend shows that siltation is threatening the dam.

Q3: Have you reviewed experiences of other countries having similar scenario as that of ours in terms of dam management or have you considered any benchmarks? How do you see about the experience from Melka Wakena?

A3: We reviewed experience and practices of other dams and it is clear that without proper management, siltation is the major problem. Experience from micro-dams in Tigray region shows us this trend.

Q4: Soil erosion is a natural phenomenon but can be exacerbated by anthropogenic pressures such as overgrazing and poor farming practices. To reduce the risk of siltation there is a need for buffer zone with vegetation cover. By what radius do we have to put a buffer zone to effectively reduce the amount of silt entering the dam?

A4: To propose the optimal size of the buffer zone, several factors have to be taken into consideration, such as erodibility of the soil, slope, erosion rate, etc. The data that we have at hand now is not sufficient to give precise figure.

Q5: The impact of population pressure on the dam was not discussed. Don't you think that it is one of the contributing factors for the siltation problem?

A5: It is clear that population pressure is contributing to factors that are responsible for increases in the rate of siltation such as overgrazing and colonization of the buffer zone. But we didn't consider it in this presentation as it is being studied in other projects within Jimma University.

Q6: During the feasibility study and construction of the dam, was EEPCo cognizant of the problem? What is the problem for not enforcing the buffer zone demarcated around the Gillgel Gibe dam?

A6: (By EEPCo) The feasibility study clearly stated the amount of silt entering the dam and based on this data the life time of the dam was calculated as fifty years and with additional conservation measures to seventy years. At present we don't have conclusive evidence that the amount of siltation in the dam is above the threshold stated in the feasibility study. Therefore we are ready to cooperate with researchers to determine the actual amount of silt and organic waste entering the dam and in dam management. A buffer zone was demarcated at 500 m radius from the dam and thousands of households from the area resettled in other sites, but because of lack of synergy between all the stakeholders (especially with the local authorities and the local community) the demarcated borders are not respected. This indicates that we have to work with the local community and have to work hard to develop sense of ownership in the community.

Q7: In explaining sediment load you considered only the suspended sediment, but what about the bed load as it is the major contributor in siltation of the dam? Have you tried to study the problem of landslide in terms of its geological formation? You mentioned deforestation as one of the reasons for landslide. But there are arguments that vegetation cover increases infiltration and in areas of shallow soil and it may cause soil saturation and consequently lead to landslide. What is your suggestion in this regard?
A7: As measuring bed load is difficult and prone to measurement errors we didn't conduct it yet but as it is important in explaining the total amount of sediment load we have plan to conduct it and now evaluating appropriate models for the activity. We considered that geologic formations of the area are contributing to the land slide but the detail study of landslide is being conducted in another project at JU. Regarding the relationship between deforestation and landslide there are different arguments. In areas of shallow soil presence of vegetation cover may increase infiltration and then soil saturation that may lead to landslide. But in south west Ethiopia there is a deep soil of > 2m where deep rooted plants may stabilize the soil and then reduce landslide. Mechanisms on how to tackle landslide are being studied in other project.

Q8: You used rainfall and discharge data from historical sources. Do you think that this can explain the present day scenario with high dynamics in runoff change?

A8: Historical data was used for preliminary study but now we are collecting our own data and still working on it.

Q9: You studied only the suspended sediment but sediment delivery to the dam was not considered. What is your plan in relation to sediment delivery?

A9: Sediment delivery was not directly measured but since the gauging stations are established near to the dam we are trying to minimize the error and suspended sediments may help us in estimating sediment delivery. Also there is a plan to measure the suspended load from the outflow (after leaving the dam).

Q10: Soil erosion may be explained as a result of variability of rainfall. I think it is hard to separate the amount contributed by surface erosion from the part contributed by landslide. How did you manage to separate the amount contributed by both factors?

A10: The suspended sediment load was measured at different sites. For the part contributed from farmland and grazing land we used the surface erosion and for the part contributed by land slide we used point of the landslide where it enters the rivers.

Q11: What is the strategy of Jimma University to disseminate research outputs to the end users?

A11: (By JU President) Jimma University has a tradition of working with the community in line with its philosophy of community based education in which students work within the community from problem identification to intervention. Based on research findings sensitization of stakeholders is regularly conducted at various forums. Regarding the findings related to Gilgel Gibe dam, we conducted a national workshop in January 2010 inviting researchers from research and teaching institutions, local authorities and EEPCo for information dissemination, feedback and awareness creation.

Q12: How do nutrient efficient crops help to diminish siltation of the dam?

A12: Nutrient efficient crops don't directly reduce the rate of siltation in the dam but by improving the livelihood of the local people may help in reducing the amount of inorganic fertilizers used which may help in reducing eutrophication of the dam.

Q13: Did you use community based watershed management assessment tools in your PRA study?

A13: PRA was used to get first hand information from the community on the problems related to land use, land degradation, biophysical resources in the Gilgel Gibe catchment.
Discussions (Continued)

(Moderators: H.E. Sileshi Getahun and Dr Teweldebirhan G/Egziabiher)

Q1: Why don’t you consider the problem of siltation and watershed management around the dam starting from the time of construction of the dam? What is EEPCo’s strategy in ensuring sustainability of the dams?

A1: The problem of dam siltation is studied as part of the feasibility study and mitigation measures are being taken just from the time of construction of the dam. Taking the case of Gilgel Gibe I, buffer zone was demarcated, communities residing in the buffer zone were resettled in other places, and planting of seedlings was conducted but the problem was lack of coordinated effort with the local authorities and the local community in decision making and implementation of the process. The strategy of EEPCo for sustainability of the dam is to work with the stakeholders to apply the recommended options during the feasibility study. From previous experiences we learned that participatory approach is found to be the best options and we go for that.

Q2: The problem of dams is not only siltation but solid and liquid wastes that cause eutrophication. What are your options for waste water treatment?

A2: For sustainability of our dams it is not only siltation that we are considering but also all factors that are contributing for the reduction in the life time of the dams.

Q3: If the dams are completely filled with silt, what would be the strategy of EEPCo? Is it abandoning the dam or are you planning to remove the silt? How do you consider the impact of climate change in the variability of rainfall and amount of water entering the dam?

A3: Mechanisms how to remove the silt will be devised in the future. The problem of climate change and rainfall variability is part of the feasibility study.
Discussions (Continued)

(Moderators: H.E. Sileshi Getahun and Dr Teweldebirhan G/Egziabiher)

Q1. Do you think that vetivers have drawback/limitations? What are the potential negative effects of the vetiver? Did you investigate other locally indigenous plant instead of vetivers? How do the vetivers will dissolve the heavy metals from the soils? What is your suggestion towards the use of vetiver in terms of its effect on biodiversity? Do you know any negative effect of vetivers on biodiversity?

A1: “To the extent of my reference and knowledge I don’t see any literature written about its draw back” for further reading you can get accessed at www.vetiver.org about the vetivers grass information. Regarding the community involvement, if we go to southern, western and northern parts of the country, nowadays farmers are naming the vetivers grass with their own local language like “Betyimar”, “ye erkensar” and “geletaw beza” and so on. They are using for thatching, ornamental and also for different purposes. For indigenous plant sought instead of vetivers, a long time ago perhaps ten years or more the World Bank has posted on their website to promote researchers if they found any locally indigenous plant to grant $10,000. It is almost 30years since vetivers has been promoted in Ethiopia however, we couldn’t get any local plants yet.

Q2. You have stated that vetivers require area enclosure around highland parts of the countries but the population density of our country on such parts of the land is too dense. So that how do you suggest feasibility of sustainable mitigation by vetivers?

A2: “If we go to northern parts of the highlands in our country’s, there are mountains and lands affected by landslides, gullies and other geo hazards, after few years we have planted on some parts of these highlands and get biomass. There are also vetiver income generation activities like cuts and carry, helping the needs. It doesn’t have also long term ecological disturbance effect in our ecosystems and biodiversity. Even around the wetlands the lost springs started to revive after vetiver grass applications. We used most of the time areas where the farmers are not used for crop cultivation. Perhaps in terms of their expectations and mental psychology they might think they are losing the land, however seems, vetiver have its own benefit for them.

Q3. What you have presented about vetiver grass is somewhat exaggerated. I have catchment visit around Gilgel Gibe area. I have seen many indigenous plants more compatible and useful as compared to vetivers grass. We have made a research in Jimma research sites. Its biological compatibility index (like crowding coefficients, aggressive index, and land equivalent ratio) is too weak. Its nutritional bioavailability is poor even its nitrogen and potassium nutrients consumption is too high. So why don’t we use those indigenous plant having better biological compatibility than the vetiver grass? Again it is not usually fed by livestock’s as you describe?

A3: “In fact our presentation is not too much exaggerated, I have tried to show you the practices of indigenous plantation like ‘Enset’ around Guragehe zone. I have tried to put those integrated work done in systematic ways as there is no regret for best practices. I have stated what I have seen throughout my thirteen years of experiences on community development of vetiver grass. For those saying vetiver grass is not used for livestock, most of the time we have made hasty decisions before we are reaching on empirical evidences. I can remember the history ‘teff’, 20 years ago; Ethiopian Government has decided to stop ‘teff’ productions and even to be removed from the list of Ethiopian staple diet. But the local farmers deny the decisions. Currently, according to the World Bank report ‘teff’ accounts greater than 20% of Ethiopian crop productions within the coming years. It has been said as a drought resistant. We better ask the local user of this vetiver grass rather than denouncing it. We are also welcome you all if you get the better indigenous plant from the local. I hope we will work together.”

Q4: Why you need to focus to train the development agent and road engineers rather than the community, because working with the communities will have more sustainable benefits?

A4: “I believe local community involvement is central parts of our work for better integration and enhancement of its sustainability. Local dwellers are currently preparing the vetiver plantation banks and act us suppliers. This is through training and awareness creation activities. However what I presented it here is the use of vetiver grass for road constructions. During road construction forefront workers are engineers, therefore we need to share them our experiences and do practical sessions how to keep the road from landslide and gullies. In general we are working with local communities. They are our assets for sustainable mitigation.”
Discussions (Continued)

(Moderators: H.E. Sileshi Getahun and Dr Teweldebirhan G/Egziabiher)

Q1: Wildlife sanctuaries and local people were in conflict for long period of time. Can you tell us the benefits the local people are getting from the participatory approach? What is your strategy in conserving the wetlands as they are better in carbon sequestration even than forests? As your enterprise is also engaged in selling wood products, does this profit oriented approach compromise the conservation of biodiversity?

A1: We identified key stakeholders to share responsibility among us. The local people are getting benefits from the new approach. We work in close collaboration with the community as experience showed us that fencing and guarding alone in the absence of the full participation of the local community cannot bring about the conservation of our forests and wildlife. Wetlands management is not in our mandate but it needs due consideration by concerned institutions. The strategy of the enterprise is not profit oriented but we are conserving the natural forest from revenue we get by selling wood products from plantations.
Summary of Moderators

His Excellency, State Minister, Sileshi Getahun, Ministry of Agriculture supplements the final conclusions and forwarded his imperative views on the essence of previous presentation and discussion point for the participants. He said ‘as state minister of water and energy point out yesterday, currently the MOWE has completed its master plan studies on Abay, Tekeze, Omo, Gibe, Baro Akobo, Mereb, Rift Valley’s, Wabeshebele and Genale Dawa basins to protect the bio-structural, physical and soil fertility for sustainable use of our water resources. This shows water resources are central to the sustainable development. Therefore integration, partnerships from different relevant stakeholders (institutions, Government bodies, Non Governmental bodies, etc) are crucial for to raise strategic issues and imply the policy directions.’

He recalled the already established, rural development and food security working group at federal level with their roles making commitment to national strategic and priority issue related to natural resources management and food security. This working group is also institutionalized under ministry of agriculture and chaired by His Excellency, Minister, Alemayehu Tegenu, Ministry of Water and Energy.

He also stated the three designed working group pillars of ministry of agriculture (MoA) on agricultural growth, natural resource management example sustainable land use forum (the team comprises of environmental protection authority, ministry of water and energy etc as a members) and food security working group. Each of these pillars has their own technical committee including different relevant stakeholders.

At regional level also similar working group were established for each already mentioned pillars especially in the main largest four regions and has started their own activities. There is also platform for sustainable land use management however there is differential among regions. Beside this, such task also decentralized to Wereda and Kebele level to implement their activities. Thus, to prevent duplication of efforts all established group should plan and implement altogether in a coordinated and integrated manner.

There are also interface and monitoring system designed at each level from national to Wereda level to enhance the working capacity. He took as an example of Sekoru Wereda working group comprises forestry, soil conservation and natural resource management, water works around the Gilgel Gibe catchment area.

In addition to the state Minister opinions, implication and clear national commitment strategic and policy directions, Dr. Tewldebrhan share his final experiences, and opinion which can help most importantly for the participants. He focused his message very shortly and in a meaningful way on the three of the following issues:

1) He emphasized the possibility of area enclosure on highlands part of the country as an issue ‘I said it is possible in highland parts of the country, even we have to make it. If we couldn’t make area enclosure, the land is used for cattle grazing and overgrazing of the land can destroy the indigenous grass. Mind you most of Ethiopians’ livelihood depends on cattle, the cattle eat the grass, we are depends on the cattle if there is no grass, there is no cattle so that we couldn’t exist because we all are interconnected. Even if we remember soil formation, it depends on the moisture, so that having buffer zone at highlands of our country is crucial.’

Dr. Tewldebrhan also gave further explanation how cutting and overgrazing hampers the productivity of land by using geometric explanation. He said “suppose if ‘x’ cm grass grows by 5cm within one week and if less than ‘x’ cm grass also grows within one week by 5cm, and if we let them protected for greater than two months. I hope the larger x cm grass will have the highest hedged so that it more useful for keeping moisture and sustainable land fertility use. This will help us for more agriculture productivity” He also took the current Mekedela Wello area enclosure as an example of no-regret best experiences. He said ‘nowadays the Mekedela land area looks 150yrs back to the history of aerial photograph made in 1860’s during emperor Tewodros era’.

2) On vetiver grass, he said ‘currently I am worrying and eager where to find out the miracles in this 21st century to save the nations and to save the earth for sustainability solutions. I understand miracles might not be perhaps always complete’ but it is very indispensable. It reminds me when I was a child hearing the story of swine from the Bible stated “when the demons were imploring Jesus not to go away into the abyss rather permit them to enter swine, he gave them permission. The demons came out of the man and entered the swine. The herd rushed down the steep bank into the lake and was drowned.” The moral of this story questioned my mind, what is the felony of the swine? If we get the best alternatives we can use it we don’t have to wait for the options till we will get the best, because until then, the problems might exceed the solutions.”
The importance of community’s indigenous knowledge another area that he emphasized. He said “Community’s indigenous knowledge shall be key entry point for our interventions. I personally recommend you first we have to exploit our indigenous farmers knowledge and also due consider our biodiversity in our ecosystem balance. We have to search for their limitations and gaps and tried to fill by looking from different perspectives. The issue of sustainable land use and degradable environment is so complex. So that having only one solution might not be good enough for our best alternatives. We have to share, integrate and work together rather than working alone.”
Group Discussions

Policy Group (G-I)

The group reached on consensus on the following key points:

Each ministry has definitive and substantive role for the management of watershed not only for Gigel Gibe I but also for all constructed dams in the country. Therefore, they have identified three levels of intervention and mitigation that they can do as a policy and decision maker.

1. Basin Level Intervention – at this level there are certain activities which are done by the ministries to mitigate the problem.

2. Area Enclosure/ buffer zone-level- at this level demarcation and protection of the buffer zone would be made.

3. Implementation Process- each ministry agreed to participate at the implementation of the mitigation measures. They strongly agreed that participation should involve all relevant stakeholders, institutions so that temporary task force shall be formulated which are highly responsible for implementation procedure for all constructed dams starting from Gilgel Gibe Dam I. The group also reached on consensus to give the leadership role to the ministry of water and energy. They also said that the detail work plan shall be prepared within short period of time.

Implementers Group (G-II)

This group discussed on the following issue:

1. About the buffer zone; i.e. focusing on 500m² area enclosure is so small enough and most of the time flood is also coming from upper catchment area; therefore intervention measures shall include both upper catchment and buffer zone. Even area enclosure for buffer zone is not well defined in participatory approach that the community intervenes in the buffer zone.

2. The other measure they discussed is about the follow up mechanism of watershed unit and system that need to be devised to make appropriate measures.

3. There are weak community involvement in the previous discussion therefore we need to focus on how to integrate the local communities to feel them sense of ownerships so as to protect the land from human anthropogenic activities.

4. There is overgrazing of cattle in the buffer zone. This needs a great attention both from the local community and the local administrations.

5. Farming mechanism is traditional and knowledge of the community about sustainable land uses is not satisfactory in upper catchment area that needs another attention to add a solution to the problem.

6. There are fragmented approaches towards the dam which need to be integrated and assimilated together to create a larger effect on the problem.

7. No compensation for some households living in the buffer zone makes community to interfere in the buffer zone of the dam. That again needs consideration in the future implementation of the mitigation measures.

8. The re-settled household were even not self-sufficient in area where they are settled therefore they need a greater support so as to make them self-sufficient and

9. Serious land degradation (landslides, gullies) in the upper catchment needs great concern to stop and minimize the problem of siltation on the dam.
Therefore, the group recommend that the involvement in the following areas:

- Designing participatory approach to manage the natural resources in the watershed area of Gilgel Gibe dam.
- Integration and cooperation of different stakeholders is sought.
- EEPCo shall strengthen its communication with local administration and communities to address the local community problem in relation to the dam.
- Awareness creation and sense of ownership (e.g. tree planting which was not sustained due to lack of community support) have a paramount importance in the management of the natural resources in the watershed area.
- Supporting the community’s development activities to create alternatives livelihood programs like cuts and carry, Income generating activities (like fishery, livestock, agro forestry etc.)
- Identify new comers and compensated dweller currently living in the catchment area so as to clearly know the community affected by the process.
- Reworking the compensation issues (homes plus farm plot)
- Sustainable land management activities in all upper watershed management and reservoir area should be supported
- Sectoral integration and lead institutions for the watershed
- Give priority to the communities in the rural electrification plan

Universities & Researchers Group (G-III)

The group talks about the role of higher learning institution and research centers on how to mitigate the watershed management. Begin from the mandate of teaching, learning, training and research. The group highly focuses on the following issues:

First, the following step has to be considered before any thing to be done includes:

1. Problem identification (e.g. siltation) but the detail of rate of siltation, by how much it contributes will be further explored.
2. Causes of the problem shall also be investigated cautiously(e.g. human activities are mentioned)
3. How to tackle the problem shall be designed
4. Make action/interventions research
5. Evaluating the interventions

ACTION/INTERVENTION: on watershed management How? The available technology will be investigated. Buffer zone shall be extended farther to all tributaries (i.e. 500m² is too small and ineffective), not to be limited to around the reservoirs only.

TRAINING

Awareness creation (making the society share the vision of saving the dam) through training, Focus group discussion, Participatory appraisal approaches, developing models for mass mobilizations

Curricular interventions (including training methodologies)

Creation of common forum and networks on dam management across higher learning institutions, research
institutions and relevant stakeholders like EEPCO)

**RESEARCH** (follow up activities on emerging issues or problems)

- To find new and better technologies to protect the reservoir
- Reviewing environmental impact assessment document done by EEPCo and do action research on gaps identified
- The effect of buffer zone size and catchment management on siltation and nutrients
- Influences of different vegetation types on siltation and nutrients removal
- Influences of solid and liquid waste management on the reservoir
- Study on integrated management of soil and vegetation
- Influence of anthropogenic activities
- Preparing research output in the form of policy briefs for policy makers, stakeholder etc
- Appraisal of resettlement options

**Development Partners Group (G-IV)**

The group made this plenary discussion and identified the following roles of development partners to mitigate the problems of the dam

- To give technical support
- Participate on capacity building at all level (federal, regional, zonal, wereda, local communities) like training, experience sharing (for example Tan abeles integrated watershed management)
- Organizational development, etc
- Financial support plus resource mobilization
- Engagement on policy dialogue and coordination platforms
- Support for research activities

**Civic Society Group (G-V)**

The role of civil societies to save our dams must focus on:

First we have to have clear objectives. Our objective is to realize integrated watershed management in the surrounding and catchments area of the dam. Then let us propose activities to be accomplished. Proposed activities by the group were:

- Participate in integrated watershed management project design
- Involve in resource mobilization
- Work advocacy
- Project implementation as well as monitoring and evaluation
- Scale up the best experiences
- Work on conflict resolution and management mechanism
Facilitate research development activities particularly natural resource management
Facilitate appropriate social and environmental impact assessment works
Work on conservation of indigenous knowledge and biodiversity
Work on rehabilitation or remedial actions
Work on networking for information and experience sharing

Ethiopian Electricity Power Corporation Group (G-VI)

This group made some argument and justification for the participants before embarking to present their roles. One important point of discussions is the previous work of EEPCo feasibility studies made an environmental impact assessment before construction of the dam, according to their presentations, this construction of dams fulfills the world standards (for construction of dams) and goes in line with Federal Democratic Republic of Ethiopia’s environment policy.

Therefore, the following baseline studies were done

1. Environmental and Social Impact Assessment (ESIA)
2. Resettlement action plan
3. Environmental management plan
4. Public disclosure and other relevant studies were made and we get in to the construction of dams with approval of concerned bodies.

Regarding to the sedimentation assumption plan about the sedimentation is also taken into consideration as part of the hydraulic structural designing of the dam. At that time the consulting bodies had conducted situational analysis. According to the study made by our consultant there are prior assumptions of sedimentation rate with maximum flow of 3.4 mill m$^3$/yr and minimum in flow of sediments 2.8 mill m$^3$/yr assuming the dead storage plan of 171 mill m$^3$/50yrs which is 3mt below the minimum operating level, secondly yesterday presentation also lack information about the rate of sediments per annum therefore it is too difficult to reach on such conclusion (that the lifespan of the dam will be shortened to 24 up to 30Yrs) Previously, EEPCo has also made watershed management depending on the study reveal however it is not satisfactory as per proposed plan.

In general, EEPCo has put the following measure to scale up its measure to protect the dam from water shedding

1. Regarding the buffer zone, currently area enclosure faced a problem and difficult for EEPCo to manage the local communities by itself, so that we need to collaborate and integrate with concerned groups and we believe EEPCo can highly participate actively on the planned activities.
2. To confirm the previous study done by one author on the economic loss of the dam, we recommend the ministry of water and energy to make the bathymetric survey.
3. Further analytical studies on water shed management on water basin are sought together with concerned bodies.
4. If the task force will be formulated, EEPCo welcomed and call for an integration
5. For the next hydro electric power planting (GG II, GGIII and others we have taken the lesson learnt and the management of ecosystem is made together with the projects.
Wayforward

The experiences of Finland embassy on Tana-Beles Integrated Watershed Management System under the umbrella of the Ministry of water and energy for water resources and since most of watershed management is agricultural activities Amhara regional state agricultural bureau take the lead on it. Therefore she recommends for formulation of working group together with explicit leading institutions to give the direction and monitors further activities.

On the contrary, a participant shared the already established Rural Development and Food Security working group on sustainable land use management having greater than 6.6 Billion birr to work on the watershed management of the Gilgel Gibe area. He added this group was already has their own technical committee, so why we need to formulate another group? Most of the time from my experience having many committees will miss commitment to work and lack shared responsibilities.

One of the participants from GG II project commented “On Regional government presentations I have my personal comment not to start about CDM project because it has its own drawback like Kyoto protocol Etc “

Comments: Let’s have consensus on master plan (because some of the group are interested to work at basin level, others at upper catchment, and buffer zone) so our integration should focus on planning where to start our interventions.

Comment: The scope of the target should be clearly put and the formulated committee’s terms of references (TOR) shall be well defined.

Comment: Still the siltation level and its impacts on the dam life year loss require further studies.

From the Ethiopian civil service society “we have clearly stated to work on the project design, I have put it on my slide presentation. Together with concerned bodies we can design the project.

From Ethiopian Coffee forest “we have considering the funding opportunity globally, I mean if we are working on forestation and or on REDD+ and CDM project we can still get the funding rather than thinking the complex world debate. We don't make plan to get these funds (international) even we didn't get from government revenue but 90% of our internal revenue is from planting and we have also made the largest community development like schooling from this budget. On the way to our works we are looking for funds to scale up more than the current limited works.”

Then H.E. State Minister, Sileshi Getahun, Ministry of Agriculture, address the importance of these two days meeting and propose the establishment of task force(temporary) led by Ministry of Water and Energy. This task force should make communication very soon and facilitate their watershed management intervention beginning from the basin level (can be classified as micro watershed and macro watershed management). I expect the task force will bring their activities onboard and take the responsibility to mitigate the problem we faced quickly.

Therefore, I propose the following institutions but not limited to shall be included in the taskforce working group. I believe also this working group will work together with the Wereda and local communities.

1. Ministry of Water and Energy --- chair/lead the group
2. Ministry of Agriculture---member
3. Ministry of Health--member
4. Ministry of Education by virtue Jimma University & Hawassa will be members
5. Environmental Protection Authority--member
6. EEPCo---member
7. CSO represented by PHE Ethiopia Consortium ---member
8. Donor represented by World Bank---member
9. Oromia Regional state---member
10. SNNPR Regional state---member
11. MoFED---member
Welcoming

Fikre Lemessa (PhD),
President of Jimma University

Your Excellency Kebede Gerba,
State Minister, Ministry of Water and Energy of the FDRE

Distinguished Guests,
Conference Participants,

Dear Colleagues,

It is indeed a great honor and privilege for me to welcome you all at Jimma University to attend the national workshop on Integrated Watershed Management on Gilgel Gibe I.

The workshop, I think, is organized with the major objective of bringing together the concerned stakeholder to discuss a very topical issue. I understand that all of you have been involved in one way or another, as actors or supporters of Integrated Watershed and Land Management interventions in Ethiopia. Poor land management practices coupled with the rugged topography, landslides, the erosive rainfall in southwestern Ethiopia can increase sediment deposition in the reservoirs and may reduce the lifespan of dams. Thus, sustainable soil use and integrated watershed management has become a focus and priority of national research with Jimma University as a major player (partner).

Jimma University in its mission statement has declared commitment to alleviate the plight of the poor and marginalized. It has also developed various community based research projects, one of these is ‘the Sustainable Use of Soil Resources and the Gilgel Gibe Dam” a multidisciplinary research project. The project focuses on improving the living condition of people in the catchments area and on increasing the lifespan of the dam. In January 2010, we conducted a workshop on “Challenges and Prospects in Integrated Watershed Management on People's Livelihood and Sustainability of Dams in Ethiopia”

As we all know, various organizations in Ethiopia have been involved in project implementation on different aspects of land and watershed management. However, results and overall impacts on the environment and people's livelihood in general varied considerably, in terms of success. Jimma University, therefore, envisages establishing mechanisms that enhance coordination of efforts, harmonization of approaches, sharing of lessons and strengthening collaborations among the various stakeholders.

The organizers of this workshop recognize that all of you have a direct stake and role to play in the various aspects of integrated watershed management, with particular emphasis to sustaining important dams of the country which is the purpose of our gathering here.

I wish you all success and hope the workshop will be productive. I felt that the presentations and discussions thereof will be instrumental for the intended objective of the workshop. I’m also confident that the workshop will come up with useful recommendations and the way forward for integrated watershed management of the Gilgel Gibe I.

Finally, I would like to owe my gratitude to all of you who have been involved in one way or another in organizing this workshop.

Thank you.
Keynote Address

Negash Teklu,
Executive Director, PHE Ethiopia Consortium

H.E Kebede Gerba,
State Minister, Ministry of Water and Energy of the FDRE

Excellencies,
Members of the Diplomatic Community,
Distinguished guests and invited participants,

I’d like to welcome you all to this national workshop on watershed management on Gilgel Gibe I after the 350 Km trip to Jimma.

Power supply is one of the critical factors required for the growth and economic development of a nation. As we all know, the Ethiopian economy has grown at a rate of 11% over the past five years. The contribution of hydroelectric power supply has been immense in the growth registered in the industry, agriculture, services and other sectors of the economy.

Ethiopia is endowed with huge hydropower energy resources with potential generation capacity of nearly 45,000 MW. However, only 2,000 MW of this potential has been exploited so far, which is 0.04 percent of the total. As a result, expansion of power supply has been given due attention in the growth and transformation plan (GTP) of the government for the next five years, with the target to increase the supply to between 8,000 – 10,000 MW. In addition to their use for power generation, there is a plan to use our dams’ sugar factories, irrigation, drinking water supply and fish farming developments.

Gilgel Gibe I dam is one of the ten large dams in Ethiopia with a watershed area of over 4,200 m². Over 254 million USD has been spent on the construction of the dam. Currently, the dam generates 184MW with an estimated 50 – 60 years of useful life. However, studies conducted on the upstream and downstream areas of the dam indicate that there is a possibility that the useful life of the dam may decrease to between 20-30 years due to siltation problem. It is therefore critical to save this important infrastructure from further losses or complete destruction due to the problem of siltation through the implementation of integrated watershed management activities in the up and downstream of the dam.

Hydroelectric power is also an attractive option at national level in line with the goal of reducing carbon dioxide (CO₂) emission required to reduce the current phenomena of global warming. It is evident that tackling these and other related issues of concern calls for the concerted efforts, time, and commitments of all concerned parties; working together, conducting relevant research, dialogues and reaching of consensuses in conferences like this. Conferences like this are therefore timely, especially in line with the current growth and transformation plan of the government.

Having said this, I’d like to thank the EEPCo for its contribution to the realization of the workshop. Paying due attention to the results of studies, and also in recognition of the role NGOs would have in solving the problem, EEPCo’s initiative to involve NGOs is really an exemplary one. PHE Ethiopia highly appreciates and values such partnership.

I’d also like to express my gratitude to JU for its role in organizing the workshop and gathering papers on demand driven research conducted by its staff with the aim of finding sustainable solution to the problem. Special thanks go to owners of the papers: Ato Endalkachew Kissi, Ato Amsalu Nebiyu and Ato Kora Tushune.
Taking this as a good start of integrating research and development, our consortium would like to express its readiness to work with universities in the country on issues of national development concern.

The ‘Sustainable Land Use Forum-SLUF’ has also played a major in the organization of the workshop. I’d like to thank SLUF for this and also for their role in sharing their rich experience in land use and development, especially in relation to Vetiver grass. Our consortium is committed to continue partnership for development with similar NGOs.
In addition, Bio-economy Africa and the Oromia Forest and Wildlife Enterprise (OFWE) deserve gratitude for being here among us to share their experience.

Heinrich Boll Foundation also deserves special thanks for the extensive support it has been extending to our consortium and its involvement in issues related to environment especially with focus on our dams. I’d like to assert that we would continue working together in future too for the success of our common goals.

On the other hand, I’m also deeply indebted to express my heartfelt gratitude to all government officials and individuals, facilitators and moderators of the workshop. Finally, I’d like to extend my deepest gratitude to invited stakeholders and members of the various mass media for your cooperation and promising motivation you showed to work with us.

While active participation and contribution from participants of the workshop is one of the major expected outcomes, we expect all to contribute to the implementation of the outcomes and recommendations of the workshop and also to pay due attention to adaptation and mitigation measures in the implementation of the GTP. Based on the current workshop, our consortium is highly committed to jointly organize similar workshops that aim at bringing sustainable development through creating strong partnership.

Your active participation is valuable for the success of our workshop.

Thank you!!
Mekuria Lemma,  
Corporate Planning Director, EEPCo

H.E Kebede Gerba,  
State Minister, Ministry of Water and Energy

H.E Sileshi Getahun,  
State Minister, Ministry of Agriculture

Regional state representatives  
Invited guest,

Ladies and gentlemen,

I’d like to express my deepest gratitude to all of you for coming to this workshop that focuses on the central theme of protecting our hydropower dams from siltation, with particular reference to Gilgel Gibe I dam.

The growth and transformation plan of our country for the next five years has envisaged a 15% growth in GDP. Based on current trends of power utilization by industries, service providers and household, the demand for power is projected to grow by 32% in response to this growth in GDP.

Accordingly, there is a plan to generate 8,000-10,000 MW of electric power from ‘renewable and green energy sources’ of the country within the next five years to realize an even higher economic growth rate than that of the previous five years.

Dear participants,

While the key strategy of achieving this huge plan rests on the exploitation of the country's renewable energy resources, hydropower would continue to take the highest share and main source of energy in the future too. We believe that protecting hydropower plants from things that may reduce their useful life would be critical to gain the full benefit of the huge investments we are making. But we also believe that this is not a responsibility that our corporation alone should shoulder. Thus, coming together to seek joint solutions to problems like this has been our dream for long. Although, Gilgel Gibe I dam has a significant contribution in the nations power supply, the threat it is facing due to the siltation problem can reduce its potential supply and useful life. It would therefore be crucial to work jointly with all concerned ministries, researchers, regional states, agriculture and environmental protection sectors offices, EEPCo, international financial organizations, government and non-governmental organizations, development partners and stakeholders.

Since siltation and sediment accumulation problem is not only a threat to existing dams but also of dams to be built in future as well, the organization of this workshop becomes a timely and a valuable intervention. Watershed management helps protect thousands of farmers whose livelihood depends on agriculture, hydropower dams and irrigation projects. It involves quite a broad spectrum of activities in various sectors by a number of stakeholders. It is therefore important to plan and implement all these in an integrated manner.

Since the workshop has gathered all concerned stakeholders, it would lay the foundation for the broad work ahead of us.

The papers to be presented on this workshop by researchers of JU and other universities, would provide grounds for evidence based interventions and also pave the way for further research on other watersheds. I would also like to stress that the outcome of the workshop is also expected to contribute towards the five years plan of growth and transformation.

Finally, I'd like to thank all the organizers of this important workshop (JU, EEPCo, PHE, and HBF); and wish a successful workshop to all of you. May I now kindly call upon H.E Kebede Gerba, State minister of water and energy to make an official opening remark?

God Bless Ethiopia!
Opening Speech

H.E. Kebede Gerba,
State Minster, Ministry of water and energy

Excellencies,

Representatives of Governmental and Non-governmental Organizations,

Researchers,
Honorable Guests
Ladies and gentlemen

On behalf of the Ministry of Water and Energy of the FDRE and myself, it gives me great pleasure to welcome you all to this national workshop on integrated watershed management to Gilgel Gibe I.

As we all know, water and the proper development of water resources is central to economic development and eradication of poverty.

Ethiopia, with average annual river flow approximately 122 billion cubic meters and a significant ground water reserve, is well endowed with water resources. Consequently, annual per capita water availability exceeds 1,500 cubic meters. So in terms of physical availability, Ethiopia is far from being a water scarce country! However, extreme variability in rainfall, and hence river flows, makes it a resource that is difficult to manage. Frequent floods and drought are the result of such extreme variability and can be overcome by construction of proper storage facilities.

Recognizing the difficulty of water management but also the potential value of Ethiopia’s water resources, the Government of Ethiopia has resolved to make water a central component of future economic development in the country in its growth and transformation plan. To this end, the ministry of water and energy has committed to enhancing and promoting interventions that contribute to efficient, equitable and sustainable utilization of available water resources.

Access to potable water supply will be increased to 98%, access to electricity to 75%, generation of 8000-10,000 MW electric power, and development of irrigation infrastructure will be increased from 2.5-15.2% within 5 years. River basin as a fundamental planning unit, the ministry has completed master plan studies of Abay, Tekeze, Omo-gibe, Baro-Akobo, Mereb, Rift-valley lakes, Wabishebele and Genale-dawa basins. Awash and Abay basins Authorities are established. Establishment of river basin councils will also be started soon. The ministry is planning to do the same in Omo-Gibe basin.

Ladies and Gentlemen,
Proper management of water resources is far from simple and climate change will make it so complex. Ensuring that benefits are maximized, equitable distributed and sustainable or better management requires detailed understanding of how complex biophysical and socio-economic systems ling and interact at a basin level rather than at catchment level. Rigorous and comprehensive research is needed to provide base to guide interventions and optimize management decisions.

As I hope, this workshop will show that research is paying off in terms of identifying and introducing good practices, and assisting us to make sound decisions in implementing integrated watershed management on Gilgel-gibe sub basin. It is research that is making a significant contribution to our ability to manage the water resources sustainably without compromising the benefit of future generation.

I think Jimma University, PHE Ethiopia Consortium, Henerich Boll foundation and EEPCO for organizing the workshop. Wishing a pleasant learning more about Gigel Gibe and happy stay in Jimma, I declare the workshop is officially open.

Thank you!
Presentations

The Sustainable Use of Soil Resources of Gilgel Gibe Dam Catchment,
Amsalu Nebiyu,
Department of Plant Sciences, Jimma University

Introduction

Low land productivity and subsequently low incomes threaten the ability of most Ethiopians to meet their basic human needs of food, shelters and clothing. Food insecurity is a major barrier to development in Ethiopia. This is due to among others, the degradation of renewable natural resources, such as land, water and forests. Southwestern Ethiopia has a strong potential for increased agricultural productivity as it generally receives adequate rainfall and the soils are relatively fertile. However, environmental challenges, mainly deforestation and hence soil erosion and nutrient depletions, have profound effect on this region. Among such land resources of great economic importance for the country is the Gilgel Gibe catchment which provides water for the Gilgel Gibe hydroelectric power plant (the largest hydro electric power dam in the country)(Fig 1). The 4225 km² catchment is occupied and cultivated by large number of smallholding farmers. However, poor land management practices coupled with the rugged topography (Fig 2). Erosive rainfall regime in the area and nutrient depletions pose major threats both to the livelihood of the farmers and the life span of the dam.

Figure 1: Gilgel Gibe Catchment, Jimma Zone

Figure 2: Rugged Topography in the Highlands of the Catchment

In view of these major threats, and the opportunities that exist for interventions, multidisciplinary research activities were formulated aiming at improving land productivity in the catchment through integrated soil fertility management practices and extending the lifespan of the Gilgel Gibe hydroelectric power plant by minimizing sediment deposition in the reservoir.
Major Thematic Research Activities in Relation to the Objectives

1. Assessment of soil degradation, sediment transport and soil and water conservation measures
2. Assessment of the soil characteristics and the spatial distribution of soils in the Gilgel Gibe watershed
3. Improving grain legume – cereal cropping systems
4. Agro-forestry (AF) options

ASSESSMENT OF SOIL DEGRADATION, SEDIMENT TRANSPORT AND SOIL AND WATER CONSERVATION MEASURES

Participatory Rural Appraisal (PRA) in selected Research Villages

PRA results have indicated that agricultural production has been constrained by the continuous biophysical resource degradation in the catchment among which decline in soil fertility and deforestation were the major ones. Frequent incidences of landslides were also other forms of resource degradation observed that seriously influence people’s livelihood in the catchment. In addition to the on-site consequence of biophysical resource degradation on agricultural production, off-site impacts like increasing sediment deposition in the reservoir of Gilgel-Gibe hydroelectric power plant is expected. It was also found that multistory home-garden agro-forestry systems represent relatively stable agro-ecosystems of the catchment and they need to be scaled up with further scientific interventions (Dereje et al. 2010).

In January 2010, a national workshop was organized for information dissemination and feedback and awareness creation. The overall results of the PRA study have been published as “Southwest Oromia Peoples Livelihood Papers No.1” (Dereje et al. 2010). In addition, proceedings of the January workshop was published in the form of book as “Sustainable Soil and Sediment Management”

![Participatory Rural Appraisal at Geshe Village, South of Dedo](image)

**Figure 3: Participatory Rural Appraisal at Geshe Village, South of Dedo**

Monitoring of Sediment Transport Rates at the Inlets of the Gilgel Gibe Dam Reservoir and at Several Sub Catchments

Sediment monitoring on a daily basis is being carried out on six major monitoring sites in the catchment (Gilgelgibe, Nada-kelo, Nada-guda, Nedie, Uneta and Bulbul rivers). Preparations are underway to establish two additional monitoring stations in the catchment. The detailed sediment monitoring study is conducted by Mr Endalkachew Kissi as part of his PhD research.

Participatory Assessment of Resource Flows and Soil Nutrient Balances

Quantitative nutrient flow analysis

At farm level, very high nutrient depletion rate (kg ha⁻¹ yr⁻¹) was observed for N (53 - 58), P (8 – 11) and K (48-53) in the highland cropping system, whereas in the lowland cropping system, high N (34 - 38) and very high P (7 - 11)
and K (23-33) depletions were observed. The differences in nutrient depletion rates between the cropping systems was due to mineral fertilizer use by the lowland farmers and more nutrient loss by water erosion in addition to the absence of mineral fertilizer use in the highland cropping system (Abebayehu, 2010). Under such circumstances, sustainable agricultural production could be under question in the future if these nutrients are not replenished timely.

**Assessment of Soil Erosion through Field Assessment and Modelling**

Explanatory assessment of sediment sources has also been conducted and landslides, river bank erosion and gullies were found to be the major sediment sources in the catchment. This assessment revealed that more than 200 hectares of severe landslide areas are connected to the major rivers (Fig 4 left), more than 651 major gullies (Fig 4 right) with a washed soil volume of about 12.3 million m³ was investigated. About 78.6% of the gullies are connected to rivers.

![Figure 4: Big Land Slide Connected to Rivers(left) and Gullies in NadaGudda(right)](image)

**ASSESSMENT OF THE SOIL CHARACTERISTICS AND THE SPATIAL DISTRIBUTION OF SOILS IN THE GILGEL GIBE WATERSHED**

Nitisols were found to be the dominant soil types in the catchment. Nitisols is one of the most productive soils of Ethiopia. It account for about 13.5% of the total identified soil types and 12% of the total area coverage of the country which rank first (23%) in terms of area converge of arable lands (FAO, 1984 cited by Alemayehu, 2009). Western and southwestern Ethiopian highland are dominated by Nitisols where the major cereal and legumes are cultivated. The other major soil in the catchment is the so called planosols (Fig 5) which is characterized by poor drainage. Water lodging is one of the problems in these vertic planosols. Studies are going on to understand their genesis, properties, distribution and proper utilization. In addition, it is hypothesized that these types of soils could be potential sediment traps in the catchment.

![Figure 5. Typical Planosol in the Catchment](image)
PROCEEDING OF THE NATIONAL WORKSHOP IN INTEGRATED WATERSHED MANAGEMENT ON GIBE - OMO BASIN

IMPROVING GRAIN LEGUME – CEREAL CROPPING SYSTEMS

Screening of legume varieties for high N fixation, high grain yield, and positive soil N balance

In order to develop an improved cropping system that involves grain legumes in the catchment, legume varieties particularly faba bean (Vicia faba) was screened for high grain yield, high biological N fixation, Phosphorous use efficiency and positive soil N balance. Hence, sixteen faba bean varieties were evaluated for nodulation and grain yield formation. Varieties with grain yield potential of 0.6 - 3.1 t ha\(^{-1}\) were identified. A field work on Biological Nitrogen Fixation (BNF) through the natural \(^{15}\)N abundance technique indicated that BNF ranged between 225-290 kg ha\(^{-1}\) with a soil nitrogen balance of between 63-88 kg ha\(^{-1}\). In addition, Phosphorus uptake and use efficiency of these varieties was found in the range of 4.47 to 10.05 kg shoot per kg P uptake.

AGRO-FORESTRY

Preliminary survey of multipurpose AF tree, shrub and grass species was carried out in the catchment, these species will be screened and characterized for soil and water conservation purpose and to stabilize river banks, landslides and gullies in the catchment based on stem and root mechanical and architectural properties. Until now, thirty indigenous spp. of trees, shrubs and grasses were preliminarily identified and seed collection undertaken from the field and forestry research center for developing seedlings for further study. Species like Syzygium guineense that are susceptible for fungus attack are already planted (Fig 6). This activity will ultimately allow to propose suitable interventions for the catchment: vegetation strips (trees/shrubs/grasses) to stabilize river banks, landslides and erosion gullies; more productive cropping systems that also better cover the soil against rainfall impact, improved agro forestry systems) that improve the livelihood for the farming communities, but at the same time reduce erosion and sediment transport to the reservoir.

Figure 6: Planting Seeds of Syzygium Species

References:


Rainfall-runoff Dynamics, and Sediment Source and Yield in Gilgel Gibe Catchment
Endalkachew Kissi
Department of Natural Resource Management, Jimma University

Introduction

25% of the world’s existing fresh water storage capacity may be lost in the next 25 to 50 years in the absence of measures to control sedimentation. Study indicated that the problem is more severe in developing countries (World Commission on Dams, 2000).

Soil erosion is a serious problem in the Ethiopian highland areas that increased sedimentation of reservoirs and lakes (Bezuayehu, 2006). Similar study indicated that sediment concentration of 16.7 kg m$^{-3}$ in Bilate river (Silesi, 2001); Koka dam has accumulated about 3.5 million m$^3$ of silt in just 23 years (Gizaw et al., 2004) and 50 per cent of the studied reservoirs in Tigray will lose their economic life before half of the design period because of siltation (Haregeweyn et al., 2005). In another study, sediment deposition rate within the catchment showed that 9·2 t ha$^{-1}$ year$^{-1}$ in the north part of Ethiopia (Nyssen et al., 2007) and 30 t ha$^{-1}$ year$^{-1}$ in south-western Ethiopia (Hurni, 1985).

The Gilgel Gibe catchment provides water for the Gilgel Gibe hydroelectric power plant. Siltation and nutrient enrichment were the major problems in this reservoir (Devi et al, 2008). The dam is under construction in the south of the Gilgel Gibe I dam. Gibe III is tallest dam in the world (BBC). Sustainability of this dam may depends on the management Gilgel Gibe I.

Picture 1. Dam Showing Gibe River

The dam will be completely filled up in 24 years whereas it was planned to serve for 70 years (Devi et al, 2008). Total cost of the project was 280 million of Euros. This country loses 7.6 million of Euros per years.

Picture 2. Picture Depicting Sectional View of Gilgel Gibe Dam
Sediment export rates in the Ethiopian highlands are characterized by important changes in sediment supply (Vanmaercke et al., 2010). There is variation among catchments in suspended sediment concentration due to the variation in the catchments characteristics in the north Ethiopia (Zenebe, 2009).

Rainfall-runoff relationship, Sediment production and delivery to rivers or dams is variable and poorly understood; due to heterogeneous lithology; various climatic conditions across small spatial scales; land use and land management. It important to study, the key sources of sediment; causes of both natural and management related sediment production and source; quantify the magnitude of sediment delivery of Gilgel Gibe watershed.

Such a study will be used for natural resource managers as a necessary precursor to provide a management and decision process for the reduction of siltation of dams; provides a base line data for policy makers to develop appropriate land management regulation.

**Research Objectives**

- To investigate the rainfall-runoff relationship of the catchment using historical records of the river discharge and rainfall
- To find out where the sediments come from in the landscape through an exploratory study
- To get more insight in the extent, causes and consequences of landslides in the catchment, and attribute to a better insight in the contribution of the landslides to a sediment load in the rivers
- To estimate the relative contribution of the sub-catchments to the suspended sediment entering the reservoir

**Materials and methods**

**Description of the study area**

The research conducted at Gilgel Gibe Catchment’s which is located some 260km south west of Addis Ababa and about 70 km north-east of Jimma. The tributary basin of the upper of Gilgel Gibe dam site is 4,225 km². Elevation of this area ranges between 1,096 and 3,259 m.a.s.l. Average annual temperature and rainfall of 19.2°C and 1535mm.

**Graph 1: Depicting Annual Rainfall Distribution in Gilgel Gibe**
• Rocks: Trachytic tuff, Vesicular basalt, Aphyric augite basalt, Ignimbrite

Map 1: Showing Soil Types in Gilgel Gibe Catchments

• Soils: Nitisols

Figure 1: Map (Left) and Graph (Right) showing the nature of Slope in Gilgel Gibe Catchments

Sediment source

• Upland at vicinity of Unta monitoring stations soil samples were taken from; grassing land, cultivated land (crop land), landslides.
• At the outlet of Unta catchment (Desera and Unta river), the sediment
• Samples were taken.
• Chemical analysis of soil (source type) and sediment samples:
• Percentage carbon, percentage nitrogen, Ca, Mg, K, Al, Mn, P, Fe, Zn, …
• Fingerprinting procedure described by Collins and Walling (2002, 2004) was used to identify the sediment source
Six gauging stations were established

- Nadie, Nad Guda, Nada Kelo, Asendabo (Gilgel Gibe), Bulbul and Unta

The stations were equipped with:

- graduated staff gauges
- Divers.

Map 2: shows Gauging Stations in Gilgel Gibe Catchments
Gilgel Gibe watershed delineated into seven sub watersheds using ArcGIS 9.3, ASTER DEM, Eth GIS –topo

Table 1 depicts Size of Sub-watersheds of Gilgel Gibe Catchments

<table>
<thead>
<tr>
<th>Sub watershed</th>
<th>Area(km²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nadie</td>
<td>592.12</td>
</tr>
<tr>
<td>Nada kallo</td>
<td>207.05</td>
</tr>
<tr>
<td>Nada Guda</td>
<td>333.45</td>
</tr>
<tr>
<td>Bulbul</td>
<td>507.85</td>
</tr>
<tr>
<td>Unta</td>
<td>285.04</td>
</tr>
<tr>
<td>Gilgel gibe</td>
<td>2255.04</td>
</tr>
<tr>
<td>Down stream</td>
<td>960.49</td>
</tr>
</tbody>
</table>
Diagram 1: portrays Discharge and Sediment Estimation

Results and Discussion
Rainfall Discharge Relationship

Graph 2: Depicting Altitude-Precipitation Relationship

- The rise in yearly RF is 2.36mm/y/m
Map 3: Rainfall stations of the Gilgel Gibe Catchments

Graph 3: Yearly Precipitation With runoff Coefficient
- no correlation between yearly rainfall and runoff coefficient (no specific trend)

Graph 4: Correlation of Rainfall and Runoff Coefficient
Sediment Source

Fingerprinting of Chemical Analysis

- For the landslide samples, the distance was maximum 5 m and for the soil samples 300m
- At the outlet of each catchment, the sediment samples were taken.

Map 4: Location of Soil Samples in the Dedo Study Area

Discriminant Function Analysis of Source Materials

- Percentage carbon was able to successfully classify 93.3% of all the source sample
- Provide powerful source discrimination.
- No single property of both source types was different enough to differentiate between the two sources.
- It is better to merge grasslands and cultivated lands in the same category, i.e. top soils
- Now, the source ascription of the sediment is only distinguishing between two source types i.e.: landslides and top soils.
Example of a recent landslide

- Landslide causing damage to cropland
- Landslide causing damage to grazingland
- Damage to house
- Damage to Electric pole
- Causal factors for landslides
Consequences of the recent landslides

Deforestation: steepest slope, good forest coverage, no landslide

Map 5: Forest in 2005 (Landsat image, by K. Getahun).
Conclusions

On a yearly basis, there was no significant change in total discharge of the Gilgel Gibe river. However, seasonally there was a rise in dry season flow (pointing to higher base flow) and a decrease in rainy season flow. A classical fingerprinting technique using chemical properties of soil and sediment revealed that top soil erosion contributed 42% and 16% to the sediment for the Unta and Desera stream, respectively.

Top soil erosion plays an important role in storm runoff events. In between those periods, landslides are the main contributing source. The 60 recent landslides replaced about 1 million m³ of slope material. It is equal to a soil loss of 50 ton per hectare per year.

The total soil loss into the rivers from landslide is estimated as 11 t / ha/ yr for the last 20 years, therefore, landslides need to be point out as an important sediment source for rivers in the Gilgel Gibe catchment. There is high variation among catchments in SSY due to the variation in the catchments characteristics in the Gilgel Gibe catchment. Gilgel Gibe has the lowest SSY (0.43 t/ha/yr) and Unta has the larges SSY (132.08 t/ha/yr).

Recommendations

There should be management of buffer zone through involving the community around the dam from planning to monitoring and evaluation stage, and make these community beneficiaries of the buffer zone. The main sediment sources of Gilgel Gibe dam are landslide and gullies. Therefore, this implies that there is an urgent need of “Bright Spots” watershed management of these hot spot of sediment sources.

In areas where individuals and communities have adopted resource-conserving and yield-enhancing technologies and management practices to increase the goods and services provided by a given land unit. Such areas are commonly referred to as ‘bright spots’. Bright spots offer the following local benefits to the individuals and communities that create them: (i) increased agricultural output and income; (ii) improved soil fertility; (iii) enhanced productivity of scarce land, water, nutrients, labor, energy and capital resources; and (iv) improved agro biodiversity and enhanced resilience.

To increase the lifespan of Gilgel Gibe dam, proper use and management of wetlands in the catchment is crucial since it is the main sediment trapping area. Establish a forum for discussion on Gilgel Gibe watershed management with researchers, community around the dam and governing body.
LOCATION

Some 260 km South-West of Addis Ababa and 70 km North East of Jimma in the Oromia Region, the Gilgel Gibe Hydro electric power plant is found.

Map 1: Location and aerial photograph of Gilgel Gibe Dam

GILGEL GIBE RIVER

Gilgel Gibe is the tributary of Great Gibe River, where the confluence is situated about 80 Km down stream from the power plant. Gibe River is the tributary of Omo River which is the principal tributary (more than 90 %) of Lake Turkana in Kenya. The Gilgel Gibe River bed stretches for a total of 176 km from its sources to the dam site.

TRIBUTARIES OF GILGEL GIBE

<table>
<thead>
<tr>
<th>The tributaries on the right side</th>
<th>Tributaries to the left side</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tiliku nada river</td>
<td>Kebela River</td>
</tr>
<tr>
<td>Nada kelo River</td>
<td>Nedi River</td>
</tr>
<tr>
<td>Siba river</td>
<td>Indichi River</td>
</tr>
<tr>
<td>Dalu river</td>
<td></td>
</tr>
<tr>
<td>Yedi River</td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Tributaries of Gilgel Gibe River

PURPOSE OF THE GGHEPP

The Ethiopian Electric Power Corporation constructed the Gilgel Gibe Power Plant as part of the country's general development plan with the aim of expanding the electric power generation capacity of the national grid known as the “Interconnected system” (ICS). The plant with a capacity of 184 MW increased the installed capacity of the grid by 25%.

Preliminary Studies and Financing

The first studies for a hydroelectric plant on the Gilgel Gibe River were carried out in 1963 by Electro project of Yugoslavia. Sometime later, a Chinese technical mission and the EPDC of Japan were also involved in the project, in 1973 and 1974 respectively. Further studies were developed in 1981 by a team of experts from the DPRK. In 1982, ACRES of Canada carried out a general power planning study. A complete feasibility study on the Gilgel Gibe Project was carried out by ENEL in 1982-83, under a contract financed by the Italian MAE.
In June 1995 ENEL/ELC Association were engaged as Consultants to revise the project design and to prepare the bid documents for International Competitive Bidding. In May 1997 the FS and the EIA were completed and submitted by EEPCO to the WB and EIB for consideration and approval. Final transactions for the insertion of the Gilgel Gibe Project in the financing scheme for Ethiopia Energy Development of the International Development Association and EIB took place in late 1997.

**RAINFALL DATA**

On the subject of average values, it appears that 60% of the total amount of annual rainfall occurs within the June-September period, 30% in the February-May period and 10% in the October-January period.

**SEDIMENTATION**

The evaluation of the solids flow in the reservoir and the calculation to determine the dead capacity of the dam was made in order to guarantee the power plant a useful lifespan of at least 50 years. The design measures, which have been used to limit downstream degradation, are illustrates here below. Three different types of data were available for evaluation of solid flow, and a comparison was made in order to estimate a reliable field of variables for the measurements. The available data were the following:

Direct measurements of sediment transport on the Gilgel Gibe carried out by ENEL/ELC association in May 1996 in correspondence to the dam section with a flow of 25 m$^3$/s. The sediment content has been found to be 0.255 g/l and divided as follows: sand 5%; Silt 23%; clay 22%; colloids 50%. The concentration of solid content is exponentially proportional to the liquid flow of the river; therefore considering the previous data and the distribution of the river flow during the year, the following table may be considered.

In the reservoir the ratio between reservoir capacity and average annual inflow is about 0.45. The trap efficiency is therefore about 80% according to Churchill and about 95% according to Brune. An annual average silt weight comprised between 3.4 and 4.0 Mt may be considered; An annual average silt weight comprised between 3.4 and 4.0 Mt may be considered as the specific weight of the sediment is generally 1.2÷1.3 t/m$^3$ the extreme annual silt volumes are as follows: vmin = 2.8 mm$^3$/year vmax= 3.4 mm$^3$/year.

**Picture 1: Intake Capacity of Gilgel Gibe Dam**
Table 2: Production Capacity of Gilgel Gibe Dam

<table>
<thead>
<tr>
<th>YEAR (EFY)</th>
<th>PRODUCTION (KWH)</th>
<th>REMARK</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996</td>
<td>1,459,087</td>
<td></td>
</tr>
<tr>
<td>1997</td>
<td>798,322,612</td>
<td></td>
</tr>
<tr>
<td>1998</td>
<td>816,682,683</td>
<td></td>
</tr>
<tr>
<td>1999</td>
<td>935,605,100</td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>883,641,505</td>
<td></td>
</tr>
<tr>
<td>2001</td>
<td>808,749,980</td>
<td></td>
</tr>
<tr>
<td>2002</td>
<td>700,951,962</td>
<td></td>
</tr>
<tr>
<td>2003</td>
<td>446,860,459</td>
<td>Up to hidar 30/2003</td>
</tr>
<tr>
<td>TOTAL</td>
<td>5,392,273,388</td>
<td>17% of 50 years prod.</td>
</tr>
</tbody>
</table>

Picture 2: Reservoir of Gilgel Gibe I Dam
Vetiver System Application for Climate Resilient Eco system  
(experience from Sida/SLUF)  
Habtemariam Abate (PhD)  
Director of Sustainable Land Use Forum

Outline
I. Land Degradation in Ethiopia
II. Sida/SLUF ENVIRONMENTAL PROGRAM
III. WHAT IS VETIVER GRASS?

Outline cont’d
IV. VETIVER APPLICATIONS FOR CLIMATE RESILIENT ECOSYSTEM
   1. PREVENTION OF
      - SOIL EROSION,
      - PRESERVING SOIL MOISTURE
      - REHABILITATING DEGRADED LAND
      - PROTECTING INFRASTRUCTURE

Outline Cont’d
2. USE OF VETIVER FOR
   - MITIGATION AND
   - ADAPTATION TO CLIMATE CHANGE

Outline cont’d
V. SCALING UP STRATEGIES
VI. CONCLUSION

I. Land Degradation In Ethiopia
- Extent: 130-400 ton/ha
- Cause: Land Use Change/ disproportion or imbalance
  - Farm Land
  - Forest and Bush land
  - Grass land
- SLM practices

Causes: LULUC

Cause: LULUC
No Regret SLM Practices

- Minimum Tillage (no till),
- restoration of degraded land (enclosure),
- pasture and grazing management (Controlled Grazing).

No Regret SLM Practices

- indigenous agro forestry (Gedeo),
- grassland management (Rotational)
- biological conservation and water harvesting practices (Grass strips).


III. What is Vetiver Grass

- Only Vetiver will be presented today
- Tropical plant (from close to mean sea level to as high as 3000 m)
- Member of the family Gramineae
- The ecotypes (Vetivera zizanioides) and Vetiver nemoralis)

III. What is Vetiver Cont'd

- Vetivera zizanioides introduced to Ethiopia from Tanzania by Jimma
- ARC some 4 decades ago

III. What is Vetiver Cont’d?

IV. Applications of Vetiver

   - Limitations of conventional physical structures in SWC (farmer’s perception)
     - Compete for land (0.75 ha)
     - Harbor rodents

A) Conservation of soil & Moisture

Conservation of moisture (WACT)

Planting across the slope (Ato Hasen Ali Farm, Uka)
Field Day (WACT)

Conservation of soil and moisture cont’d

Gully Rehabilitation (WACT)

Soil conservation Cont’d

Soil Con. (Cont’d)

Semi circle planting & mulching (Thailand)

Gully rehabilitation (Thailand)

Planting material cont’d

B) Use of Vetiver on flat lands for production of planting materials and mulch

Homestead Vetiver Nursery (‘Vetiver Bank’) Wedeb-Eyosus Kebele - East Gojen

C) Use of Vetiver for infrastructures

Planting M & Mulching Cont’d

Mulching (Tirana Agricultural Research Center)

Untreated dam side Vetiver treated dam side after 6 month (Thailand)
CO2 in the atmosphere has increased from a preindustrial value of about 280 (ppm) to 379 ppm in 2005.

Best case computer climate models estimate that the average global temperature will rise by 1.8° C to 4.0° C by the year 2100, which will not be tolerable by human kind and plant species.

Sequestration of atmospheric carbon into subsoil horizons is one of the strategic measures.

Fast growing grasses with penetrating deep root system would facilitate long-term locking of atmospheric carbon.

Income and livelihood diversification is one among the several strategies available to enhance social resilience in the face of climate change.

On top of its ecological services, vetiver is used for livelihood diversification such as fodder/feed, fiber and food (generating income) for local communities.

It’s leaves and roots can be used for roof thatching as well as making handicrafts to raise income.
IV. Scaling Up Strategies

1. Training and experience exchange
   
   TOT for ERA road engineers

2. Publications and information (website, newspapers, leaflets):

3. Planting material

4. Government should be firmly committed to the up-scaling of VS and should incorporate VS use into all relevant sectors.

Advocacy and Lobby Cont’d

- EPCCO:
  - 2 Central Nurseries
  - Official Letter by Ministry
  - Organising this Conference

Advocacy Lobby

- MOA
  - SLUF SLM TC Member
  - Including Vetiver into EthioCat
  - Member of Vetiver Network
  - Joint training of Regional SLM Staff
  - 1 Watershed GG1 Financed
  - Participate CSOs in implementing SLM?
Advocacy Lobby Cont’d

- EPA
  - 3 Watersheds pilot programs
- 4 Factories Pilot Programs
- Goal: Integrated and participatory programs (Climate resilient ecosystem around renewable energy sources)

Advocacy lobby cont’d

- ERA
  - Joint training of road engineers (practical skill + Theoretical)
  - Member of vetiver network
  - Bid/tender documents of roads
  - Primary access roads through vetiver
  - Road side stabilization-Metu-Gore road

Advocacy lobby Cont’d

- His Excellency president Girma
  - 30 minutes discussion
  - Promised to scale up/out
  - Best practice booklet prepared (A Copy distributed)

Scaling Up Cont’d

7. Policy support to attract Bilateral and multilateral funding agencies (GG1 70 – 20 years)
   - G1, G2, G3 Cascaded, CC

Scaling up cont’d

8. Monitoring systems to be developed to identify VS applications and impact. High-resolution satellite imagery can do this purpose.

9. Leadership
   King Of Thailand is vetiver Patron
   ETWN wishes renowned personality to provide leadership of vetiver promotion in Ethiopia

IV Conclusion

- Based on the past 20 years of experience in Ethiopia and more than 100 other countries worldwide up-scaling of VS in Ethiopia could be done relatively quickly (10-20 year program) and would have great impact on poverty reduction and the betterment of a sustainable environment including climate change mitigation and adaptation.
The Miracle Grass: The Vetiver System Application
Ato Debela Dinka
Sustainable Land Use Forum (SLUF)
SMALL FARMERS USE THE VETIVER SYSTEM

Indian farmers in Myanmar have been using the Vetiver grass for generations for erosion control and farm boundary demarcation. Very few people had realised this. The leaves are cut every three weeks for forage.

30 YEAR OLD VETIVER HEDGEROW

DEVELOPES 2 METER HIGH TERRACE RISER

Vetiver hedgerows planted on a 20% slope in Fiji had developed a terraced form 2 meter high after 30 years.

FIFTY YEARS AFTER PLANTING

HEDGEROWS STILL FUNCTION

Vetiver hedgerows near Rakiraki, Fiji

EROSION CONTROL

Right: 1.0 meters of sandy sediment was trapped behind this vetiver hedge in Malaysia in one year.

Left: Vegetation grows on 50% slope in the highlands of NE Thailand with vetiver protection.

SOIL AND WATER CONSERVATION

Sabi Valley, Zimbabwe:

Trees do not prevent erosion—their roots may be massive, but they are not dense enough.

Lands had once been stabilized with engineered earth embankments. The farmland was left to move water from the downstream reservoir and the vetiver restored the lost waterway and became this huge gully.

THE SOLUTION

Upper Catchment - Gully Rehabilitation Using Vetiver Grass

40 Years After Planting - Fiji

Madagascar 200 km FEC Railroad

Annually destroyed by Typhoons. Impacts economy of 200,000 people

FARMER AND COMMUNITY VETIVER PLANTING ON FEC RAILWAY RIGHT OF WAY

COMPLETE, STABLE AND PRODUCTIVE

}

PROCEEDING OF THE NATIONAL WORKSHOP IN INTEGRATED WATERSHED MANAGEMENT ON GIBE - OMO BASIN
PROTECTED AND IMPROVED WATER SOURCE

COMMUNITY PROJECTS IN THAILAND

VETIVER FOR THATCH

VETIVER FOR BUILDING AND MANUFACTURING

VETIVER SYSTEM FOR COMMUNITY WASTE WATER TREATMENT

VETIVER ROOTS

VETIVER - A COMMERCIAL CASH CROP - PLANT MATERIAL

North Alumina Refinery, Gove, Northern Territory

Wall repaired after cyclone damage

Six weeks after planting

WATERSHED MANAGEMENT ON GIBE - OMO BASIN
Expensive concrete shoulder dyke built to protect culvert outlet

Vetiver hedges planted on edge of road shoulder provide same protection but cheaper and more effective

Vetiver hedges planted on edge of road shoulder to protect culvert inlet, note no erosion

Vetiver hedge traps loose road gravel, reinforcing the road shoulder

Collect and divert surface runoff to concrete sluice
Integrated bio economy system for sustainable water shed management
Solomon Worku (PhD)
Bio- Economy Africa

Social Dimension
- Limited quality education
- Political and social instability
- Poor governance
- Human insecurity
- High prevalence of HIV/AIDS, Trype/Malaria, Tuberculosis & Blindness
- Population pressure
- Gender inequality
- Limited interconnection across Africa

Economic Dimension
- Limited economic integration
- Poor socioeconomic infrastructure
- Restriction of free movement and trade
- High level of poverty
- High level of food insecurity
- Limited foreign investment in Africa
- Insignificant contribution to world trade
- Underdeveloped industry

Sustainable Livelihood: New Solutions to Old Problems:
1. Use more of what you have (coconut mapping).
2. Use it more efficiently/differently (sack gardening, biogas units).
3. Reduce constraints (tsetse/malaria control).
4. Use appropriate new technology (solar ovens).
5. Integrate activities (bio-farms).
7. Job & Market Creation

Livelihood Challenges
- Population Increase?
- Land Scarcity?
- Human Health & Education?
- Cash Crop & Access to Markets?
- Animal Production & Health?
- Soil Fertility & Erosion?
- Water?
- Shelter?
- Energy?
- Infrastructure?
Cactus fruits are already used....

More efficient use of soils, e.g. Vertical Agriculture & Sack Gardening

Biointensive Farming

More efficient use of resources, e.g. Biogas Units

Biogas Units under construction at Wakra

Reduce constraints on resource use, e.g. Tsetse Control

Efficient, under-built traps can be built by the communities to manage their own tsetse/tsetse problems - Community Participation.
First analysis of IBS activities in Benishangul Gumuz:

- While spending significantly less time preparing their plans

- Time taken to prepare plans:
  - 0-10 days
  - 11-26 days
  - More than 30 days

Integrated Bioeconomy System

Scaling-out

Praxis Network in Africa

- Yalu has already established links with Mozambique, City of Kinshasa and Democratic Republic of Congo; several demonstration sites have been planned or are under study.

Global Praxis Network
Forests and Environmental Services
Girma Amente (PhD)
Oromia Forest & Wildlife Enterprise (OFWE)

Why OFWE was established? Because:

Oromia accounts for 70 % of the highland forest cover of Ethiopia. The need to reverse the prevailing alarming rate of deforestation; the need to promote forestry as competent land use option; and the need to enhance the contribution of the forestry sector for the socio-economic development are some of the reasons for its establishment.

This calls for an independent institutional set up that enables the retention of the revenues generated from the sector to be re-invested within the sector and support key rural development activities in and around the forests. An appropriate institutional set up in this regard is thought to be a forest enterprise.

OFWE was established in June 2007. It has eight forest branch offices and one forest industry unit, which includes Jimma branch. It is a self-financing institutional set up, 90 % of the revenue of the enterprises is expected from plantations and natural forests for conservation. Total concession area includes, about 1.75 million ha of high forests, Bamboo forests to be demarcated, Woodlands to be demarcated, additional land to be identified by land use studies.

Major Objectives

- To conserve the existing forest resources by involving local communities living in and around the forests,
- To develop new forests to increase the forest cover of the region,
- To sustainably utilize the forest resources to fulfil the demand for forest products (includes replacing imported wood and exporting some products),
- To contribute to the economic development of the region and Country.

Environmental services provided by forests

- Carbon sequestration (biggest reservoirs of carbon, they help to keep the carbon cycle and help reduce climate change)
- Biodiversity conservation (Forests harbour about two-thirds of all terrestrial species),
- Catchment protection (Regulation of quality and quantity of water, protection of erosion)
- Eco-tourism
The impacts of watershed degradation on our hydroelectric power plants and the Economy

- Low water levels in dams (resulting in low use of capacity),
- Siltation and sediments in the water itself (causing high cost of turbine maintenance),
- The reduction in generation of hydroelectric power adversely affect the manufacturing and other industries.

This in turn adversely affects the economy of the country.

Experiences in Payment for Environmental Services (water)

- Increasing trend in payments for PES in Latin America, North America and Asia countries
- Countries like Costa Rica are investing some of the revenues generated from Hydro in to watershed management
- However, experinces from Asia show that the benefits from PES is not enough to offset the opportunity costs of ongoing unsustainable land use
- Kulekhani watershed in Nepal ($1.5 per capita for communities from hydro royalties)
- Singkarak lake watershed, Indonesia ($1 per capita)

Best practices on PES deals

- They are based on clear and consensual scientific evidence linking land uses to the provision of services;
- Contracts and payments are flexible, ongoing and open-ended;
- They rely on multiple sources of revenues delivering money flows that are sufficient and sustainable in time;
- Compliance, land use changes, and the provision of services are closely monitored; and
- They are flexible enough to allow adjustments to improve their effectiveness and efficiency and to adapt to changing conditions.

The role of forests in Climate Change Mitigation

Woody plant cover, which occupies 1/3 of the land surface accomplishes almost ½ of the world’s annual photosynthetic fixation of carbon. On the contrary deforestation contributes to 20 % of the total carbon emission. Therefore, to enhance the contribution of forests in climate change mitigation, increase the forest cover by planting new trees; reduce deforestation.
The Example of Bale REDD+ project

Bale eco-region Sustainable Management programme funded by The Netherlands, Norway and Ireland Embassies. Total forest area under the project is 0.5 million ha. The average deforestation rate in the area is 3%. Study was conducted to quantify the amount of carbon credits that can be traded by reducing emissions from deforestation. The Project Idea Note (PIN) is already developed and we are looking for voluntary and compliance markets. It is serving as demonstration site for our National REDD+ development process. In Cancun it is agreed to move forward with REDD+ which is an opportunity.

Recommendations

- Afforestation and reforestation programmes should be supported within the Gibe watershed, which can be also developed in to CDM projects
- The conservation of existing natural forests should be supported, which can also benefit from REDD+ funding
- The central role of forests in the watershed should be carefully planned and integrated.
Jimma University: An overview

Jimma University, located in south western part of the country, in Jimma town, 360kms outside Addis Ababa is one of 2nd generation universities in Ethiopia. It was established in 1997; the constituent institutions are much older, 27 and 55 years. It has three campuses (Main campus, COAVM and Kito Furdisa), all in Jimma town; University Teaching Hospital is part of the main campus

- Jimma university is organized into six colleges and two institutes, namely:
  - College of Agriculture and Veterinary Medicine
  - College of Public Health and Medical Sciences
  - College of Business and Economics
  - College of Engineering and Technology
  - College of Social Sciences
  - College of Natural Sciences
  - Institute of Health Science Research (IHSR)
  - Institute of Education and Professional Development

- Hosts 51 undergraduate and 46 graduate programs
- Enrolls 33,027 students (16,644 regular, 16,383 continuing and distance; 31,952 undergraduate and 1,075 Postgraduate students)
- Has 3,110 staff population: 1,260 academic, 1,545 administrative and 305 health service professionals; there are about 74 expat staff mostly indians
- Is the national pioneer in Community Based Education (CBE); CBE is implemented under three strategies known by acronyms CBTP, D/TTP and SRP.
- It values partnership in teaching, research and service; closely works with local community and various GOs and NGOs
- Is engaged in rapid expansion of educational programs, both horizontally and vertically
- The recently issued higher education proclamation requires universities to be more autonomous, entrepreneurial and accountable
Principles and values

- Excellence and quality
- Diversity, tolerance and inclusiveness
- Equity and access
- Gender sensitivity
- Honesty and integrity
- Transparency and accountability
- Community involvement and empowerment
- Networking and partnership
- Mutual respect, collegiality and team spirit

Major Collaborators

- National:
  - Sector ministries
  - Research institutes
  - Higher education institutions
  - Federal and regional governments and local administration
  - The community (industry, NGOs, CSOs and local community)

- International
  - VLIR-Institutional University Cooperation, Belgium
  - Tulane University, USA
  - Yale University, USA
  - Brown University, USA
  - Nova Scotia Agricultural College, Canada
  - McGill University, Canada
  - Munich Maximillan University, Germany
  - Copenhagen University, Denmark
  - Wageningen University, The Netherlands

- Munschener fur Munschener
- NUFFIC
- CDC-Ethiopia
- Clinton Foundation
- Various NGOs
Gilgel Gibe HEP Dam Area is currently serving as:

- Gilgel Gibe Field Research Center (2005)
- Jimma University-VLIR Institutional University Cooperation (IUC) research projects (2007)
- Community Based Education (CBE) programs
  - Community Based Training Program (CBTP)
  - Development/Team Training Program (D/TTP)
- Research site for many research projects (WHO/TDR, Harvard University, CDC, etc)

An overview of the research activities of IUC programme

- IUC partner program is the university development cooperation program that is run under VLIR by VLIR-UOS
- VLIR is Flemish acronym that stands for interuniversity council of higher education institutions in Flanders, Belgium, established in 1976
- It receives the funds from DGDC; manages university development cooperation funds on behalf of member institutions

Key features of IUC partner program:

- Long-term
- Based on priority areas of partner university
- Phase-in, phase-out and consolidation strategies
- Fostering collaboration and matchmaking (not traditional aid?)
- Comprehensive in its support and mobilization of expertise
- Promotion of networking (NS, SS and NSSC)
- Distinctive management structure

- Is implemented in two phases:
  - Phase I (the first five years) is meant to focus on capacity building
  - Phase II (the second five years) is consolidation, application and phase-out
  - Post IUC period support (7 years)

- The first seven years funding is 100% (£745000), year eight 85%, year nine 75% and final year 50%
- Following 10 years there is phase out process: support through competitive research funding

**Academic Objective**

To enhance the quality of teaching and research undertaken in Jimma University (JU) through planned and targeted development of human resources and collaborative and multi-disciplinary researches of an international standard that addresses the priority problems of the local community and the country at large.

**Developmental Objective**

To improve the life of the people in Gilgel Gibe HEP dam area and the surrounding region and promote sustainable development through conducting research into problems and issues of human and animal health, environmental health and ecology, food and nutrition and soil fertility and promoting evidence based interventions in the target area in collaboration with different stakeholders.
Research Projects

• Project 1: Animal Health
• Project 2: Child health & Nutrition
• Project 3: Environmental Health and Ecology
• Project 4 infectious diseases Epidemiology & Modeling
• Project 5: Soil Fertility

Support and coordination

• Project 6: ICT / Library
• Project 7: Research Coordination
• Project 8: Program Support Unit (PSU)

Research areas in Animal Health project:
- Bovine Trypanosomiasis (PhD)
- Animal Nutrition-locally available feed resources and nutritive values (PhD)
- Mastitis (PhD)
- Fasciolosis, GI Nomatodes, Helmenth infections, Zoonotic diseases

Research areas in Child Health and Nutrition
- Food intake & optimization of Complementary food (PhD)
- Case detection of malnutrition in children
- Psychomotor study (PhD)
- Nutritional status and its determinants
- Food security and adolescent health, nutritional status and life aspirations
- Improving child feeding with especial emphasis on food quality and safety.
- Nutrition support to HIV positive children under treatment

Research Areas in Environmental Health and Ecology Project:
- Solid waste study
- Liquid waste study
- Remediation techniques in Solid waste (PhD)
- Liquid waste technology (PhD)
- Assessment of Pesticides risks (PhD)
- Aquatic ecology (PhD)
- Coffee Genetic biodiversity (PhD)
– Coffee Quality (Joint PhD)
– Spatial analysis and land use dynamics (PhD)
– Forest fragmentation (PhD)
– Forest-Wild life interaction (PhD)

Research Areas in Infectious Diseases Epidemiology & Modeling Project
– Survival analysis (PhD)
– Modeling of Youth health (PhD)
– Mathematical modeling of HIV infection (PhD)
– TB/HIV prevalence study
– Evaluation of WHO TB/HIV treatment guidelines (PhD)
– Malaria incidence around Gilgel Gibe Dam area
– Vector ecology

Research Areas in Soil Fertility Project:
– Cereal-Legume rotation (PhD)
– Sediment transportation and monitoring (PhD)
– Agro-forestry (PhD)
– Soil survey and characterization, nutrient flow analysis (MSc)
– Planosols (PhD)

Support and Coordination
• ICT & Library Project
  – Staff training in:
    • Mail system and intranet portal
    • Network system administration
    • Library automation and cataloguing
  – Equipment and material support to ICT & library
  – ICT CRCs
• Research Coordination Project
  – Coordination of research activities (baseline survey, synergy)
  – Data center service
  – Non-thematic (emerging) research areas
    • Male involvement in FP: couples perspective (PhD)
    • Evaluation of Ethiopian Health Extension Program (PhD)
• Program Support Unit (PSU)
  – Program management
  – Program promotion and communications
  – Laisoning
Ongoing contributions of the partnership program

- Staff capacity building
  - Long-term training
    - 30 PhD
    - 4 masters level training (two are local)
  - Short-term trainings
    - 42 in Belgium (27 in year 1 and 15 in year 2)
    - More than 12 local training courses.
- Graduate program support
  - Masters program in Biostatistics
  - 2 PhD programs are being developed and will be launched in 2011
- Research infrastructure development
  - Advanced research labs, strengthening graduate programs
- Institutional capacity building
  - ICT, Library
- Community engagement
  - Evidence for policy (economic development and poverty alleviation)
  - Community services (CRC, schools, extension services, etc)

Final words

- Research agenda should be defined through active participation of the stakeholders
- Researchers, policy makers and practitioners should work together to bridge the prevailing gap between research and policy
- Higher education institutions should be active players in the development agenda and assume more responsibility in the issues of population, health and environment.
Closing Remark

H.E. State Minister, Sileshi Getahun, Ministry of Agriculture

Dear all, today we came to here for Gilgel Gibe I issue to integrate our water shed management to mitigate its life span. It is know that water resource management, sustainable land use management has interconnected and also an input for economic development. Our economy highly depends on agriculture; so that it is one of the greatest contributors for source of an economy this requires a due attention from all stakes.

Today’s discussion is most importantly focused on siltation and sediments due environmental degradation and other geo hazards threatening the economic life span of the Gibe I dam. If appropriate measure couldn’t be taken very soon even the reservoirs are also can be damaged. Therefore in order to improve its hydro electric power generation more than the current capacities we need to make an immediate intervention. The issue of Gilgel Gibe I exceed beyond Dam and its reservoir but it is the issue of our country’s economic development. We understand the use of electric power. If there is no power all our development will be hampered because the services, industry expansions are highly depends on the power we generate. It is not about to prevent the siltation and sediments, but we have to do for its economic utility.

These two days is warm and participation of all stakeholders are admirable and interesting how ever I feel there are the missed stakes from this workshop, the local communities from kebele to local leader shall participate because help as to put our work easily on the ground during our implementation activities. Such kind of workshop also should call the local dwellers so as to share their experiences. In addition we need to consider the role of women participation on development agenda. I saw few female represented even by development partner.

I hope we will consider the above message and urge the organizers to send us the copy of this workshop proceeding mainly for Ministry of water and energy very soon.

I thank all organizers of this workshop namely PHE Ethiopia Consortium, Henerich Boll Foundation, Ethiopian Civil Society Organizations, EEPCo and Jimma University; particularly I am grateful to Jimma University for their permission of this invaluable auditorium and their hospitality.

Thank You!
Field Excursion

‘We generate power for Ethiopia: Connecting to the future’
EEPCo

It was on the third day of the workshop, the participants led by the organizers were departed in the morning at 8:00am from Jimma town to Gilgel gibe catchment area. Three spots were expected to be visited during the excursion. 70 km way from Jimma town historic panorama of the dam with its amazing land escape of reservoir is observed at a distance. The visit was completed at noon.

![Panorama of Gilgel gibe dam I (side view) with its algae reservoir (taken on December 25, 2010)](image)

Spot 1: Dam with its reservoir:
The participants reached the station and started visiting the rock filled asphalt faced dam having crest elevation of 1675m. a. sea level and maximum height of 41m. The reservoir has a total storage at maximum normal water level (FSL) equivalent to 839Mm³, live storage and dead storage of 668M m³ and 171M m³. The surface area of the lake at 1671 m a.s level of water level (FSL) is 51km².

<table>
<thead>
<tr>
<th>Ser no</th>
<th>Characteristics</th>
<th>Unit measurement</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Type of dam</td>
<td>-</td>
<td>Rock fill asphalt faced</td>
</tr>
<tr>
<td>2</td>
<td>Crest elevation</td>
<td>meter</td>
<td>1675 m a.s l.</td>
</tr>
<tr>
<td>3</td>
<td>Max. height</td>
<td>meter</td>
<td>41m</td>
</tr>
<tr>
<td>4</td>
<td>Crest length</td>
<td>meter</td>
<td>1700m</td>
</tr>
<tr>
<td>5</td>
<td>Crest width</td>
<td>meter</td>
<td>7</td>
</tr>
<tr>
<td>6</td>
<td>Slope up/down stream</td>
<td>ratio</td>
<td>2:1</td>
</tr>
<tr>
<td>7</td>
<td>Embankment volume</td>
<td>m³</td>
<td>3,000,000</td>
</tr>
<tr>
<td>8</td>
<td>Asphalt facing area</td>
<td>m²</td>
<td>105,000</td>
</tr>
<tr>
<td>9</td>
<td>Grout curtain area</td>
<td>m²</td>
<td>40,000</td>
</tr>
<tr>
<td>10</td>
<td>Plastic diaphragm area</td>
<td>m²</td>
<td>20,000</td>
</tr>
<tr>
<td>11</td>
<td>Reservoir max water level(FSL)</td>
<td>m²</td>
<td>1671 m a.s l.</td>
</tr>
<tr>
<td>12</td>
<td>Reservoir minimum water level(DSL)</td>
<td>m²</td>
<td>1653m.a.s.l</td>
</tr>
</tbody>
</table>

Table 1: showing the area characteristics of Gilgel gibe I, south west Ethiopia, December 2010

During the visit the participants were admired by the topographic panorama of the dam and also saw vetivers grass initiatives nurseries site of the EEPCo.
However, the color of water bodies of the reservoir becoming so green raised the points of discussion and question for the EEPCo presenter about growth of algae which is common in Ethiopian lake resulting in increased nutrients (like phosphate and nitrates) and depletion of available oxygen level. This process is called Eutrophication which is defined as an increase in the rate of supply of organic matter in an ecosystem. It is the natural slow aging process for water bodies, but human activities (fertilizers run off and sewage discharge) greatly speeds up the process. Increased sediment depositions can also eventually raises the level of the lake or river bed, allowing land plants to colonize the edges and convert the area to dry land (Lawrence and Jackson, 1988). The process of conversion of algae into biofuel also important idea mentioned during the visit. But, the presenter pointed out no specific measures has been taken yet by the EEPCo, and they are interested to all researchers to work with them to find further solutions.

Still the EEPCo visiting organizers told the discussant about the sedimentation rate that the dam construction design was estimated about 50yrs economic benefit taking in to accounts considerable maximum flow rate of 3.4 mm$^3$ and minimum sediment flow rate of 2.8 M m$^3$. Since there is no study conducted showing the rate of silitation and or rate of sediments around the reservoir, it is too hasty conclusion to postulate the economic loss of the dam without empirical evidence. Nonetheless, the dam still requires protective water shed managements (from both natural and manmade threatening condition to extend its life yrs by 20yrs. The group has also made discussion on livelihood measures provided for the nearby dwellers, and get the response from the EEPCo field coordinator that there is fishery micro finance project on the lake. But he reminds the participants the scope of EEPCo is to generate, transmit, and distribute and sale the power to the customer. The work of livelihood program needs integration and involvement of other stakeholders.

**Spot 2 : TAIL RACE OUTLETS**

After 9km with high speed cars the participants reached the power plant station of Gilgel Gibe I. before starting the visit, about 500 meter from the left side of the power plant there is tail race outlet having an evacuation area equivalent to 51.82m$^2$; final lined area equals 31.67m$^2$. Its cross section is like horse shoe and its length and diameter approximates 700m and 6.25m respectively. This outlet released the total amount of water about 100m$^3$/sec down to Gilgel Gibe II as one of the main tributaries going 26km away through tunnels and generate 420MW of energy. Here, the water that turned the Gilgel Gibe I turbines flows through the pipelines (translational kinetic energy, because the energy in the water is being moved,) called tailraces and enters the river through the outflow. The water is back to being kinetic/mechanical/potential energy as it is in the river and has the potential to have the energy harnessed for use as it flows along (movement.)
Spot 3: The power house: the place where dynamics energy transformations

Water has the ability to do work (Mechanical energy), the energy motions (kinetic energy) the potential to do work (potential energy). The potential and kinetic/mechanical energy in water is harnessed by creating a system to efficiently process the water and create electricity from it.

One way to the power house is through the tunnels, about 9km underground so as to allow gravity to carry the water down to the turbines. There is one gate for an entrance made of cylindrical shape Diameter to height 6.5m*4m, tower height of about 62m. The power house is located in underground having the dimension of 83*40*22.5m (L*H*W) and excavation volume of 61,000m³.

The power Tunnel has 9,205m length from the intake and control gate lined with concrete portion of 8,796m. It has circular cross section of 5.5m internal diameter.

Gravity will force the water to fall to a lower position through the intake and the control gate. When the gate is opened, the water from the reservoir goes through the intake and becomes translational kinetic energy as it falls through the next main part of the system: the penstock. The water is falling (moving) from the reservoir towards the turbines through this penstock. The penstock is a long shaft steel lined underground total length 711m with internal diameter of 5m that carries the water towards the turbines where the kinetic energy becomes mechanical...
energy. The force of the water is used to turn the turbines that turn the generator shaft. The turning of this shaft is used to rotate the generator shaft and finally convert the energy of water into electricity.

There is underground concrete lined cylindrical surge shaft with internal diameter of 14m, and a total depth of 110m. This surge shaft is used for controlling the Pressure Variations, due to rapid changes in the pipeline flow, thus eliminating Water Hammer possibilities and help to regulate the flow of water to the Turbine by providing necessary retarding Head of Water. There is a vertical shaft depth of 166m containing three branches (units) manifolds. Each of the unit has rated capacity to produce 70MW and rated water discharge of 33.91 m³/se. The three manifolds internal diameter is approximated to 5m, 4.1m, and 2.9m having the maximum estimated pressure of 3.5MPa that uses flowing or falling water to create power by means of a set of paddles mounted around a wheel. There is also lower surge gallery used to relief the pressure congestion.

There is concrete lined electric cable shaft connecting to the switch yard of about 175m height above the earth surface. There are set up auto transformer 1*40MVA, 230/132 Kv and the general auto transformer is about 3*73MVA, 13.8/230KV synchronized to Interconnected system of Gedo, Jimma, Sebeta, kaliti substations. The transformer takes the alternating current and converts it into higher-voltage current. The electrical current generated in the generators is sent to a wire coil in the transformer. This is electrical energy. The Generators are synchronized directly coupled to vertical shaft and the three Francis turbines with the capacity to produce 73MVA each by a factor of 0.9 power rate. And its estimated speed is about 428.57rpm.

Generally, Gilgel Gibe I is one of the potential energy assets of the country producing 184MW with average energy per annum of 722 GWH. Gilgel Gibe I is not only the power source but also discharge significant amount of water with rate of 100m³/se(33.91m³/se each turbine) which is used for Gilgel Gibe II and Gilgel Gibe III hydro electric power as the main source of the tributaries along its way to Gojeb and Omo River. Therefore mitigating Gilgel Gibe I will help to enhance the sustainability of the current capacity to produce greater than 2000MW power from the three projects.

![Picture 5 Inside the powerhouse, Gilgel gibe I power plant](image-url)
# Workshop Schedule

## National Workshop on Integrated Watershed Management on Gilgel Gibe I

### 23-25 December, 2010

### Jimma University and Gilgel Gibe I

#### Day 1

<table>
<thead>
<tr>
<th>Time</th>
<th>Presentation</th>
<th>Presenter</th>
<th>Facilitator</th>
</tr>
</thead>
<tbody>
<tr>
<td>6:30am</td>
<td>Travel to Jimma</td>
<td></td>
<td>PHE Ethiopia Consortium, EEPCo, Sustainable Land Use Forum &amp; Jimma University</td>
</tr>
<tr>
<td>1:00-2:00pm</td>
<td>Lunch (Jimma University)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2:30 – 2:40pm</td>
<td>Welcome and Opening Ceremony</td>
<td>Jimma University President</td>
<td>Organizing committee</td>
</tr>
<tr>
<td>2:40 – 2:50pm</td>
<td>PHE Ethiopia Consortium</td>
<td>Heinerich Boll Foundation</td>
<td></td>
</tr>
<tr>
<td>2:50 – 3:10pm</td>
<td>EEPCo, Ato Meheret Debebe</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3:10 – 3:20pm</td>
<td>Opening</td>
<td>Water and Energy Ministry</td>
<td>H.E. Ato Kebede Gerba (State Minister)</td>
</tr>
<tr>
<td>3:20 – 3:30pm</td>
<td>Exhibition</td>
<td>Ethiopian Vetiver Network, ECSNCC &amp; Jimma University</td>
<td>PHE PHE Ethiopia Consortium, EEPCo, Sustainable Land Use Forum &amp; Jimma University</td>
</tr>
<tr>
<td>3:30-3:50pm</td>
<td>Tea/Coffee Break</td>
<td></td>
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<tr>
<td>4:20 – 4:30pm</td>
<td>Impact of Climate Change on our Dams</td>
<td>Dr. Aklilu Amsalu, Addis Ababa University</td>
<td></td>
</tr>
<tr>
<td>4:30 – 4:50pm</td>
<td>The sustainable use of soil resource of the Gilgel Gibe Catchment</td>
<td>Ato Amsalu Nebiyu, Jimma University</td>
<td></td>
</tr>
<tr>
<td>4:50 – 5:10pm</td>
<td>Sediment budget of the Gilgel Gibe catchment, south west Ethiopia</td>
<td>Ato Endalkachew Kisse, Jimma University</td>
<td></td>
</tr>
<tr>
<td>5:10– 5:30pm</td>
<td>Population Pressure</td>
<td>Prof. Tefera Belachew, Jimma University</td>
<td></td>
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<tr>
<td>5:30-6:30pm</td>
<td>Discussion</td>
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#### Day 2

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<thead>
<tr>
<th>Time</th>
<th>Presentation</th>
<th>Presenter</th>
<th>Facilitator</th>
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</thead>
<tbody>
<tr>
<td>8:30 – 9:30am</td>
<td>EEPCO’s presentation</td>
<td>Ato Mekuria Lemma, EEPCo</td>
<td>Dr Tewoldebirhan G/ Egziabher &amp; Ato Silesi Getahun (State Minister of Agriculture Ministry)</td>
</tr>
<tr>
<td>9:30 – 9:50am</td>
<td>Vettver System Applications for climate change resilience: Experience of Sida/SLUF Environmental Program</td>
<td>Dr. Habtemariam Abate</td>
<td></td>
</tr>
<tr>
<td>9:50 – 10:10am</td>
<td>The “Miracle Grass”</td>
<td>Ato Debela Dinka</td>
<td></td>
</tr>
<tr>
<td>10:10-10:30am</td>
<td>Film on vetiver grass</td>
<td>SIDA/SLUF by FFE</td>
<td></td>
</tr>
<tr>
<td>10:30-11:00am</td>
<td>Importance of Integration</td>
<td>Dr. Getachew Tikubet</td>
<td></td>
</tr>
<tr>
<td>11:00 – 11:15 am</td>
<td>The role of OFWE and CDM and REDD+ opportunities</td>
<td>Dr. Girma Amente</td>
<td></td>
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### Day 3

<table>
<thead>
<tr>
<th>Time</th>
<th>Presentation</th>
<th>Presenter</th>
<th>Facilitator</th>
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</thead>
<tbody>
<tr>
<td>7:00 – 8:30am</td>
<td>Travel to Gilgel Gibe</td>
<td>PHE, Jimma University</td>
<td></td>
</tr>
<tr>
<td>8:30 – 9:00am</td>
<td>Tea Break</td>
<td>EEPCo</td>
<td></td>
</tr>
<tr>
<td>9:00-9:30am</td>
<td>Gilgel Gibe I site visit</td>
<td>Eng. Getenet, EEPCo</td>
<td></td>
</tr>
<tr>
<td>9:30- 10:00am</td>
<td>Vetiver grass nursery site visit</td>
<td>Dr. Hailemariam, SLUF</td>
<td></td>
</tr>
<tr>
<td>10:00 – 12:00am</td>
<td>Discussion on site</td>
<td>Jimma University</td>
<td></td>
</tr>
<tr>
<td>12:00 – 1:30pm</td>
<td>Lunch</td>
<td>EEPCo</td>
<td></td>
</tr>
<tr>
<td>1:30pm</td>
<td>Travel back to Addis Ababa</td>
<td>PHE Ethiopia Consortium</td>
<td></td>
</tr>
</tbody>
</table>

Organized by: PHE Ethiopia Consortium, EEPCo, Jimma University, Heinrich Boll Foundation and Sustainable Land Use Forum.