Proceedings of the Wetland Awareness Creation and Activity Identification Workshop in Amhara National Regional State

Co-hosted by

Amhara National Regional State Bureau of Agriculture,

Wetland Action

and

Ethio Wetlands and Natural Resources Association (EWNRA)

Facilitated by The University of Huddersfield, UK

January 23rd 2001 Bahar Dar, Ethiopia

ewnra

Amhara National Regional State Bureau of Agriculture

Wetland Action

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Edited by

Alan B Dixon, Afework Hailu and Adrian P Wood

Amhara National Regional State Bureau of Agriculture

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Participants of the Wetland Awareness Creation and Activity Identification Workshop in Amhara National Regional State, January 23rd 2001, Bahar Dar, Ethiopia.

Contents

Note
This workshop was developed in response to a request by Dr Belay Demisse to Afework Hailu of the Ethio Wetlands and Natural Resources Association (EWNRA) to provide an input to start a process of raising awareness about wetlands in the Amhara National Regional State. EWNRA was happy to arrange this workshop and invited its supporting partner Wetland Action to also engage in the workshop. Wetland Action supplied staff through one of its members The Wetlands and Natural Resources Research Group (WeNReG) of the University of Huddersfield. Two staff from WeNReG acted as facilitators of the workshop.

The various participants covered their own costs to attend the workshop and the accommodation for the meeting was provided by the Amhara Regional Bureau of Agriculture who also provided coffee and tea. A dinner reception for the workshop participants was hosted by Dr Adrian Wood on behalf of Wetland Action.

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Glossary

AAU	Addis Ababa University
ANRS	Amhara National Regional State
ARARI	Amhara Regional State Agricultural Research Institute
BD Un	Bahar Dar University
BDU Foe	Bahar Dar University Faculty of Engineering
BoA	Bureau of Agriculture
BU	Bahar Dar University
CIDA	Canadian International Development Agency
CSE	Conservation Strategy of Ethiopia
DOA	Department of Agriculture
EA	Environmental Assessment
EIA	Environmental Impact Assessment
EU	European Union
EWNRA	Ethio Wetlands and Natural Resources Association
EWRP	Ethiopian Wetlands Research Programme
FAO	Food and Agriculture Organisation of the United Nations
FRTC	Fisheries Research and Training Centre
GOs	Government Organisations
HU	Huddersfield University
IBCR	Institute for Biodiversity Conservation and Research
IUCN-EARO	International Union for the Conservation of Nature and Natural Resources - East Africa Regional Office
LFDP	Lake Fisheries Development Project
MFM	The Menschen fur Menschen Foundation
NGO	Non Government Organisations
PA	Peasant Association
PRA	Participatory Rural Appraisal
PSU–CIDA	Program Support Unit - Canadian International Development Agency
Sida	Swedish International Development Agency
UNDP–GEF	United Nations Development Programme - Global Environment Fund
USAID	United States Agency for International Development
WeNReG	The Wetlands and Natural Resources Research Group

Welcome Speech

Koyachew Mulluye

Regulatory Department Head, Amhara National Regional State (ANRS), Bureau of Agriculture (BoA)

Distinguished guests,
Gentlemen,

I welcome you to this first Regional Workshop on Wetlands in the Amhara Regional State and it is a great honour for me to welcome you to Bahar Dar.

Amhara National Regional State is one of the largest regions in the country. Its size and variability in altitude, climate landform and ecology have enabled it to be endowed with rich natural resources and biodiversity. Wetlands are one of the natural resources, which have a direct impact on people. Besides the immediate economic benefits, biodiversity resources including the maintenance of the food web and food chain. However the traditional agricultural practices in the region are also believed to have negative effects on wetlands.

At present, little is known about the actual coverage and level of wetland use, although the region has numerous rivers, including international ones, lakes and depressions (like the *Fogera* and *Chefa* plains). It is, however, clear that there is conflict between crop and livestock productions and this gives us some idea of how much our wetlands are endangered and under increasing threat.

There is, therefore, a need to study and use wetlands in a sustainable manner in line with the interests of different stakeholders. Among these stakeholders, we participants of the workshop are here today to consider the preliminary general picture of wetlands in the region. Having this initial picture, the workshop is expected to develop a framework to study wetlands and how to intervene in wetland management on the basis of research results. I believe this workshop is a good opportunity for laying down a profound framework since many of you have rich experience and serious concerns about wetlands.

Finally I would like to thank all of you for your immediate positive response to our invitation and for coming to the workshop.

I now call upon Dr Belay Demissie, Head of Bureau of Agriculture, to open this workshop.

Thank you.

Opening Speech

Dr Belay Demissie

Head, Amhara Regional State Bureau of Agriculture

Dear invited guests and gentlemen:

In the first place on behalf of BoA and myself, I would like to welcome you to Amhara Region, Bahar Dar and to this Regional Wetlands Awareness Creation and Activity Identification Workshop.

The Amhara National Regional State is bordering with the Sudan and Benishangul-Gumuth in the West, Tigray in the North, Oromya in the South and Afar Region in the East. The region's total area is approximately 170,152km^2 and the total population is about 16 million, of whom 90% are rural. The economy of the region is predominantly agricultural based with crop-livestock production system.

The production and productivity level per unit is very low due to many manmade and natural problems. The major contributing factors are, low levels of improved technology application, moisture stress, high population pressure, poor infrastructure development, deforestation, land degradation, lack of appropriate policy and strategies, etc.

Gentlemen:
To at least sustain peasant agriculture, natural resource deterioration should be halted. Among the various manifestations of resource degradation, the case of wetlands is the one that has been given high attention at certain levels of government and international organisations. The people of the region have been depending on wetlands as a source of water for consumption, and as a source of food, pasture, transport, and aesthetic value. The growing dependence of man on wetlands causes serious degradation in some wetlands. In my opinion, this is happening due to a lack of awareness about the importance of wetlands and their proper management among officials, and experts and at community levels. The perceptions of people on the wetlands ecosystem vary from place to place. Usually they are seen as wastelands, as dangerous places, as unhealthy places and so on.

The degradation of wetlands is known to be severe and alarming which is not only against the principles of proper and rational resources use, but also against the government policies and the international Ramsar convention. So, knowing the special nature of the wetlands ecosystem and the benefits they provide we have to design policy and strategy to properly conserve and utilise wetlands in a sustainable manner.

Dear Workshop Participants
The objectives of this workshop are

- Awareness creation on wetlands
- Identifying the gaps or problems facing the wetlands and
- Recommendations for future action

At this stage please allow me to extend my sincere appreciation to the workshop participants

who have come from different areas covering their own costs and the initiators and organisers of the workshop from Wetland Action, Ethio Wetlands and Natural Resources Association and BoA staff.

I hope that you will have a fruitful discussion in this workshop. Finally I would like to declare that the workshop is officially opened.

Thank you.

The Role and Importance of Wetlands in Ethiopia

Dr Adrian Wood

Reader in Geographical Sciences, The University of Huddersfield, UK and Wetland Action

Abstract

Wetlands are a very important aspect of the environmental resource base of Ethiopia. They produce a range of ecological and socio-economic benefits in their natural state which contribute to the well-being of rural communities and the environmental security of the country. However, wetlands are often seen as wastelands that have no value and are best converted by drainage to allow agriculture or grazing. Such conversion may create some new benefits - increased food production and grazing, but will generally cause the loss of many other benefits. Indeed, in the end, the net result of converting wetlands can be serious environmental degradation and loss of benefits to the community. The economic analysis of this process shows that wetlands are most valuable when used in a way that maintains their natural functions and to do that conversion must be limited.

1. Defining Wetlands: The Importance of Water

Wetlands is a term which has been developed to describe a range of situations where land is affected by water. The following definition shows this predominant role of water.

> *"Wetlands are areas where water is the primary factor controlling the environment and the associated plant and animal life. They occur where the water table is at or near the surface of the land, or where the land is covered by shallow water."* (Davis, 1994)

For an area to be a wetland, water does not have to be at the surface, but it has to be close enough to the surface and for long enough to allow anaerobic (airless) conditions to develop in the soil. Some wetlands may be permanently flooded, whilst others may have water close to the surface for only a few months in a year.

Wetlands are known by various names depending on the extent to which water is the dominant feature. In some cases the water is usually within the soil, as with peatlands, but the term wetlands can include shallow lakes. However, water is always a dominant feature of wetlands. These points are covered in this further definition.

> "*Wetland are areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres."* (Davis, 1994).

2. Characteristics of Wetlands: Vegetation, Soils and Fauna

Because of the dominance of water, wetlands have special characteristics which tend to favour particular types of plants and soils. Depending on the degree of inundation, water-dependent and water-associated plants are found in wetlands and only there. In south-west

Ethiopia typical wetland plants include: *Cyperus latifolius*, (*cheffe*), *Cyperus brevifolius*, *Anagallis serpens* and *Fuirena stricta*.

Wetland soils have anaerobic (airless) conditions because of the flooding. This slows down decomposition of organic matter. As a result these soils tend to be high in organic matter and of high fertility.

Wetlands provide a unique habitat which is used by many wild animals. In particular it is known that several bird species are mainly found in wetland areas. Two particular wetland adapted birds are found in the Illubabor wetlands: Roget's rail (*Rougetius rougetii*) and Wattled Ibis (*Bostrychia carunculata*). Roget's rail is currently classified as a near threatened species.

3. Wetland Resources of Ethiopia

Although wetland resources of Ethiopia are not fully documented, it is known that they represent a significant micro-environment in many parts of the country. The FAO Land Use Map of 1984 identifies only two types of wetlands:

- Swamps – that are usually flooded areas with emergent vegetation of more than one metre above the water level;
- Marshes - that are wet areas (with water above or below ground) with short vegetation.

These two wetland types cover an estimated 1803 km^2 (0.16%) of the country's surface.

In addition there are other important water dominated areas throughout the country which should be included in the wetland category. These include shallow lakes and the margins of the Rift Valley and other lakes, the floodplains of major rivers (e.g. the Baro-Akobo, the Omo and the Awash) and swamp forests. As a result, the total area of wetlands in Ethiopia may exceed one per cent of the country (11250 km^2). This may appear small but it is very important for the country's ecology and for many people who use these areas (See Sections below on Benefits).

Wetlands are most common in the wetter parts of the country. For instance in Illubabor, the land use records from the Ministry of Agriculture show that 256 km^2 (1.6%) of the zone is covered by wetlands. Again, this only includes marshes and swamps and when floodplains, lakes, ponds and swamp forests are included this may reach five per cent of the zone (800 km^2).

4. Benefits and Hazards from Wetlands

Wetlands are often considered to be wastelands which are of little use to anyone. They are thought of as nuisances and are associated with problems such as mosquitoes, diseases and floods. They are also regarded as obstacles to human development. As a result they are often converted, usually by drainage, and used for a variety of new uses such as cultivation, grazing or building, especially for industry in urban areas. However, in their natural state wetlands provide a range of ecological and socio-economic benefits. Most of these are lost when the wetlands are drained. This loss of benefits can have serious impacts upon the wellbeing of rural communities. (See Section below on Trading Benefits in Converted Wetlands.)

4.1 Ecological Benefits from Natural Wetlands

Wetlands help maintain the functioning of ecological systems, especially the hydrological system, in many ways. The most important of these ecological benefits include:

- recharge of groundwater, with various implications including maintenance of springs;
- moderation of stream flow, reducing flooding and helping maintain dry season flows;
- water storage throughout the year;
- purification of water through the functioning of reed beds;
- filtration of water flow and sediment trapping.

4.2 Socio-economic Benefits from Natural Wetlands: Ecological Functions

These ecological functions also have various socio-economic impacts which contribute to the well-being of rural, and sometimes urban, households. These include maintenance of domestic water supply, protection of hydroelectric power supplies in the dry season, reduced ill health through water purification and protection of dams from siltation.

4.3 Socio-economic Benefits from Natural Wetlands: Products

Wetlands in their natural state provide a range of products for people. Some are always present but others will depend upon the nature of the wetland. These products include:

- domestic water from springs around the wetlands;
- water for clothes washing and cattle watering;
- reeds for thatching, crafts or floor covering;
- palm materials for craft activities;
- medicinal plants;
- grazing for cattle during the dry season, and
- fish.

4.4 Additional Benefits in Converted Wetlands

When wetlands are converted, usually by drainage, some additional benefits may be obtained. These can include:

- an early cereal harvest, which can help improve food security by providing food during the “hungry season”;
- cash crops such as vegetables, or sugar cane which can be sold, and
- wet season grazing when the upland fields are all under cultivation.

4.5 ‘Trading’ Benefits in Converted Wetlands

Although wetlands can provide these additional benefits when they are converted, many of the original benefits from the natural wetland may be reduced or even permanently lost if the whole wetland is drained. Some of the benefits which may be lost include:

- spring water supplies,
- cleaned stream water,
- flood control,
- sediment trapping,
- reeds for thatching,
- palm products,
- medicinal plants, and

- dry season grazing.

The hydrological system can be seriously altered by the drainage of wetlands, with higher levels of floods and reduced baseflows during the dry season. Hence there is a trade-off of benefits when wetlands are converted by draining.

4.6 Limited Benefits from Converted Wetlands: Degradation and Wider Impacts

The agricultural benefits from drained wetlands are often difficult to sustain. Wetland soils may loose their fertility after drainage because of oxidation, acidification and other processes which take place once the anaerobic conditions are removed. Soil compaction may also occur as a result of trampling by grazing livestock. This damages the soil structure and can reduce water storage and rainfall infiltration. In these ways wetlands can become degraded and some or all of the additional benefits from drainage may be lost.

Also, as the ecological functions are disrupted by draining wetlands, many people can be affected. Local people may no longer find water in their springs, while people a long distance downstream may be seriously affected by worsened floods and increased fluctuations in streamflows, or lack of water for the generation of electricity. In addition people who are using the upslope areas around drained wetlands will find the water table is lowered and may experience poorer crop yields, for instance with their coffee or bananas.

This combination of changes, which undermines the ecological functioning of wetlands and their ability to support agriculture, means that wetland conversion by drainage may lead in the medium term, to few benefits being available from wetlands. In that situation wetlands end up as rough grazing, with perhaps some eucalyptus plantations and brick making taking place within them. These latter two land uses can be seen as terminal for wetlands as they destroy their hydrological and ecological functioning.

5. Beneficiaries of Wetlands

The range of benefits provided by wetlands contributes to the wellbeing of many people. In some rural areas all households will get water and reeds from their nearby wetland. However, not all households will benefit equally from wetlands, whether natural or converted. For instance, not all people make craft goods with wetland products, and only a few persons have the knowledge to collect medicinal plants. When wetlands are drained, use of the new benefits is often restricted as not all households have the labour, oxen and skills with which to cultivate wetlands.

Hence there are four major questions which need to be asked about wetland use and conversion:

a) Who are the people who benefit from wetlands locally?
b) Who are the people who benefit from wetlands downstream?
c) Who will be affected by any changes made in the way wetlands are used, such as drainage?
d) How are the benefits and problems of wetland use and change distributed between men and women?

It has to be pointed out that as wetlands are drained only some group’s gain. It is usually the better-off who have the resources with which to cultivate these areas, while people with cattle, who are also relatively rich, benefit as wetlands become more useful for grazing. In contrast,

larger sections of society may lose out if other benefits, such as water supply, reeds and medicinal plants, are destroyed and are not available from alternative nearby sources. In particular women may find their workloads greatly increased when springs dry up due to wetland drainage and they have to walk further to obtain safe water supplies.

It should also be noted that other people outside the immediate wetland using community can be affected by wetland drainage. These include downstream communities who find the stream or river flow altered with increased flooding and lower dry season flows. People farming the slopes surrounding wetlands can also be affected by the lowered water table which can affect their crops.

6. Lessons for Policy

The key implications from this analysis for policy makers and planners alike are that:

- wetlands are assets whose values in their natural state should be recognised and valued;
- wetland benefits come from both their ecological functions and the socio-economic value of these and the products they produce;
- the various socio-economic groups benefit differently from wetlands depending on whether the wetlands are in their natural state or converted by drainage;
- women may be particularly disadvantaged by wetland drainage;
- conversion of wetlands by complete drainage reduces the overall range of benefits produced by wetlands and involves a trade-off of benefits, with some gains and some losses;
- maintaining new agricultural benefits from wetlands following drainage is usually difficult to achieve and sustain;
- as a result wetlands are often degraded in terms of their hydrological, pedological and biodiversity characteristics by conversion and end up as rough grazing.

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Wetlands Distribution in Amhara Region, Their Importance and Current Threats

Abye Kindie

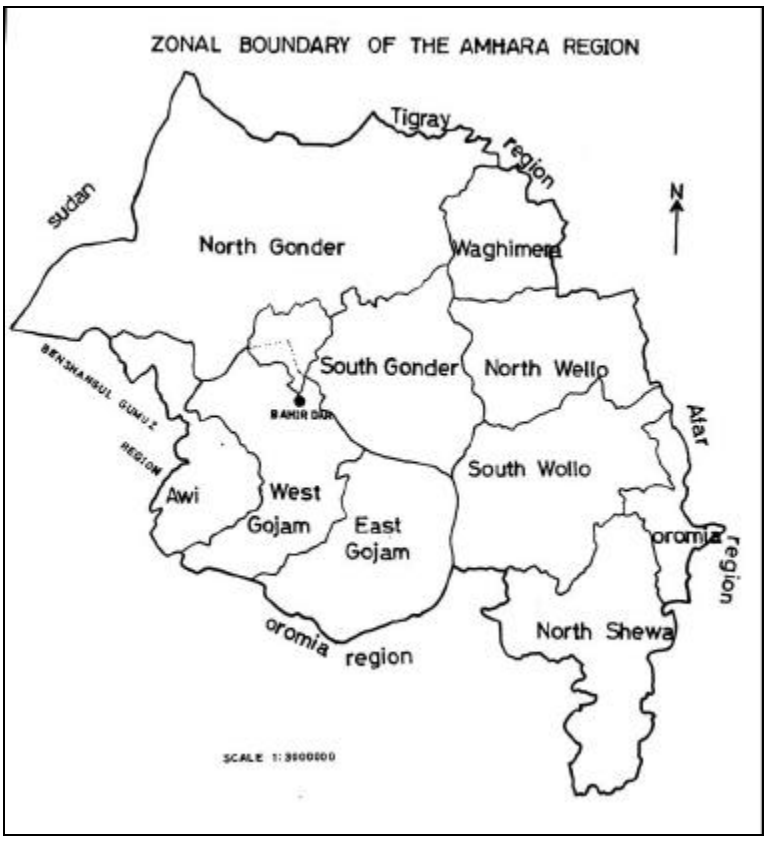
Bureau of Agriculture, Land use Planning and Regulatory Team, Bahar Dar

1. Background

The Amhara National Regional State extends from 9^0 to 13^0 45'N and from 36^0 to 40^0 30"E. It is bounded by Tigray in the north, Oromia in the south, Benshangul and Sudan in the West, Afar in the East. It covers approximately 170,152km^2 and it is moderately compact in shape (Figure 1). The regional state is made of ten administrative zones namely Wag Hamra, North Wollo, North Gondar, South Gondar, South Wollo, North Shewa, Oromia, East Gojjam, West Gojjam and Awi. These zones are subdivided into a total of 105 weredas.

The topography of the region is characterised by a diversified elevation, the lowest point being in the north west of the region (Metema and Matibia Weredas in North Gondar) at about 600m elevation, while the highest point is the top of Ras Dashen Mountain which is about 4260m above sea level. The wetlands in the region cover about 3.7% of the area and include areas of seasonally flooded grassland, water bodies, and permanently flooded papyrus grass swamp.

Figure 1 - Administrative Zones within Amhara Region.

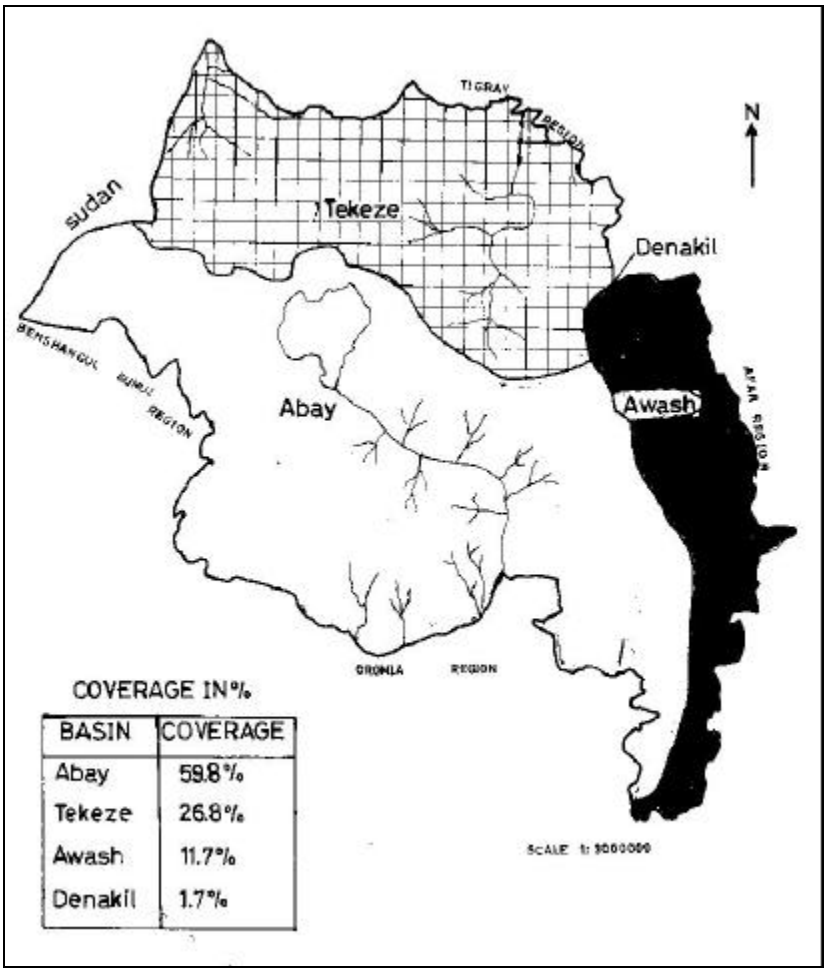


2. River Basins of the Region

The Amhara region is a source of several great rivers that flow from the higher parts of this region into the low lying areas in and outside its boundaries, e.g. Abay, Tekeze and others. These rivers make an important contribution to the different wetlands at their source and on their way.

Because of their altitude, the mountains of the region act as a major watertower and form the headwaters of trans-boundary rivers. The region has four major basins with rivers and their smaller tributaries. These are the Abay, Tekeze, Awash and Danakil basins (Figure 2). The share of the region covered by these basins are 59.8%, 26.8%, 11.7% and 1.7% respectively.

Figure 2 - The Major River Basins of Amhara Region.



3. Distribution of Wetlands

The wetlands in the region cover about 288,744 ha of swamps and marshes and 316,609 ha of the water bodies. These wetlands are distributed all over the region. However, the largest portion of the wetlands is found in Abay River basin in Awai, West Gojjam, and South Gondar administrative zones. The nature of wetlands is not well studied but according to the information on the 1:50,000 topographic map the wetlands are divided in to three classes such as water body, marsh or swamp and area subjected to inundation. It is not only the Abay basin that contributes to the wetlands of the region. The Awash basin also has a significant area of wetlands, especially in South Wollo and Oromia administrative zones. The distribution of the wetlands of the above administrative zones are shown in Figure 3 and Table 1.

Figure 3 - Distribution of Wetlands in Amhara Region.

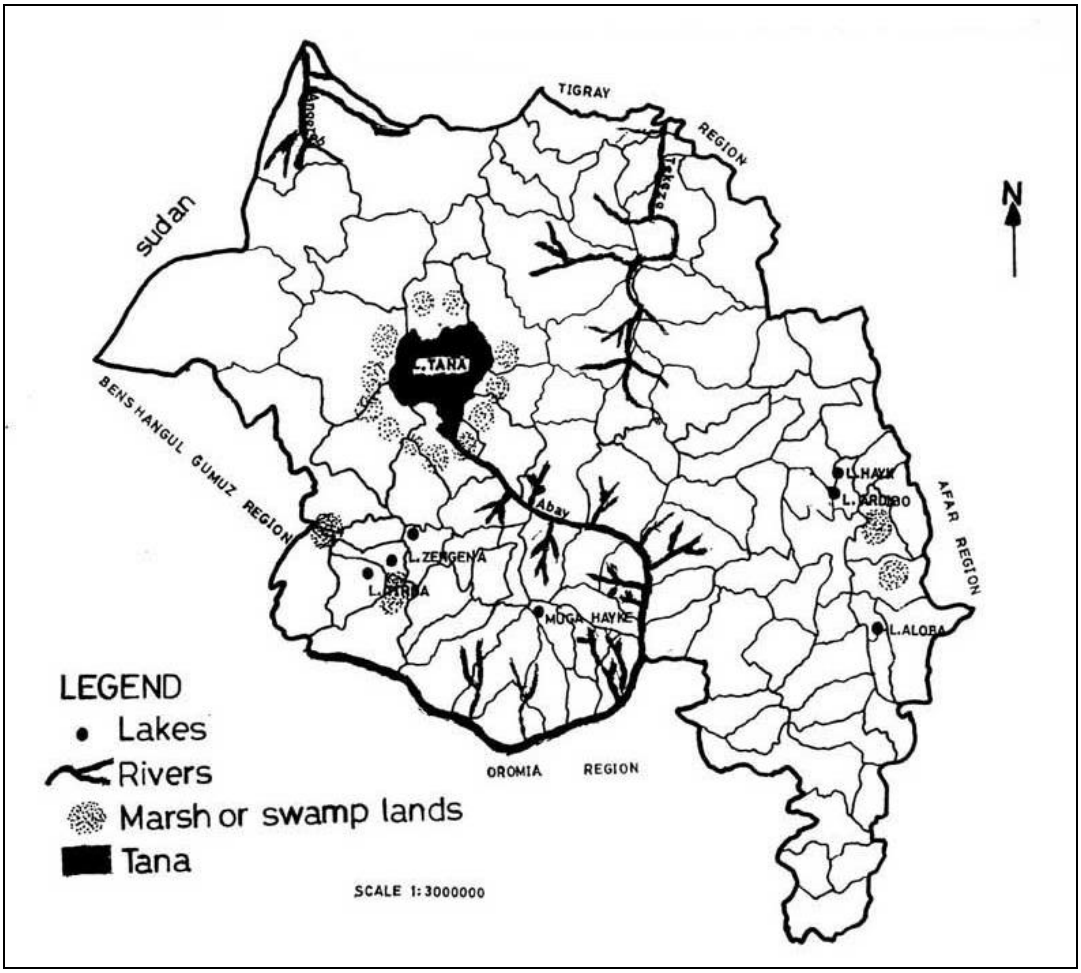


Table 1 - Wetland Area within Amhara Region.

Zone	Water body (ha)	Marsh or Swamp area (ha)	Area subjective to inundation (ha)
East Gojjam	485	20960	29400
West Gojjam	114700	6190	35900
Awi	825	1900	4500
South Gondar	164300	-	2100
Bahar Dar	16000	300	2000
Total	**280310**	**29350**	**73900**

4. Importance of the wetlands

Wetlands in the region are important resources that supply essential raw materials such as reeds for the farming community for thatching purposes and the head of papyrus which are very important for ceremonial use. Wetlands are also the major source of drinking water for humans and livestock. Furthermore, wetlands play a vital role in the economic lives of many peasants in the region. They are used for fishing, growing crops, grazing and transportation. The presence of water is a significant feature of ecosystems and is a principal factor attributing biodiversity and richness of habitat. Lake Tana at Bahar Dar and Lake Haik in

South Wollo, as well as the Fogera plains in South Gondor are also suitable habitats for many bird species.

Table 2 - Wetlands of Bahar Dar Zuria and Achefer Weredas (Around Lake Tana and Gilgel Abay river)

Wereda name	Class of Wetlands	Area (ha)	PA (Peasant Association)
Bahar Dar Zuria	Swamp	1050	Lata Amba, Lejome
	Seasonal swamp	4900	Debranta, Sekelet Giorgis, Lata Amba
	Area subjected to inundation	1800	Wonjeta, Debranta, Sekelet Lata Amba, Iriste Mariam
Achefer	Swamp	800	Legdia
	Area subjected to inundation	2900	Estumet, Chimba

Source: Bureau of Agriculture Land Use Team 1997

5. Current Threats

Due to population pressure and the subsequent demand for more resources to sustain rural livelihoods, wetlands are now under threat in Amhara Region. In some parts of the region many wetlands have been drained for agricultural production.

Generally the degradation of the region's natural resources is a major issue and this is well recognised by the regional government. To alleviate natural resource degradation, the government has approved a land use policy and established "The Land Administration and Use of Rural Land" proclamation and established the Environmental Protection, Land Administration and Use Authority. At present, the Authority is not officially established but its structure is under consideration. The main objectives of this authority are:

1. Ensure that matters pertaining to the region's social and economic development activities are carried out in a manner that will protect the welfare of human beings as well as sustainably protecting, developing and utilising natural resources. (Proclamation No 47/ 2000, Part Two, Article 4, Sub-Art. 1).
2. Create a conducive atmosphere by which the management, administration use of rural land of the region could be appropriately decided pursuant to the federal and regional constitutions (Proclamation No 47/2000, Part Two, Article 4, Sub-Art. 2).

6. Limitations

This paper is only an introduction to the wetland situation in the Amhara National Regional State. This is because there is no complete data and information about the extent and nature of wetlands and there is as yet no capable manpower to study and assess the region's wetland resources.

7. Conclusion

To take forward the study of wetlands in this region and improve their management and contribution to development, it is necessary to make an inventory of the wetlands in the region with special emphasis on their extent and nature. To do this it is necessary to strengthen the region's manpower with skills in wetlands and facilitate this through the provision of technical and logistical support.

Lessons and Challenges of Agricultural Research in Amhara Region: Advice for future research work on Wetlands

Dr Gete Zeleke

Acting Director, Amhara National Regional State Agricultural Research Institute (ARARI)

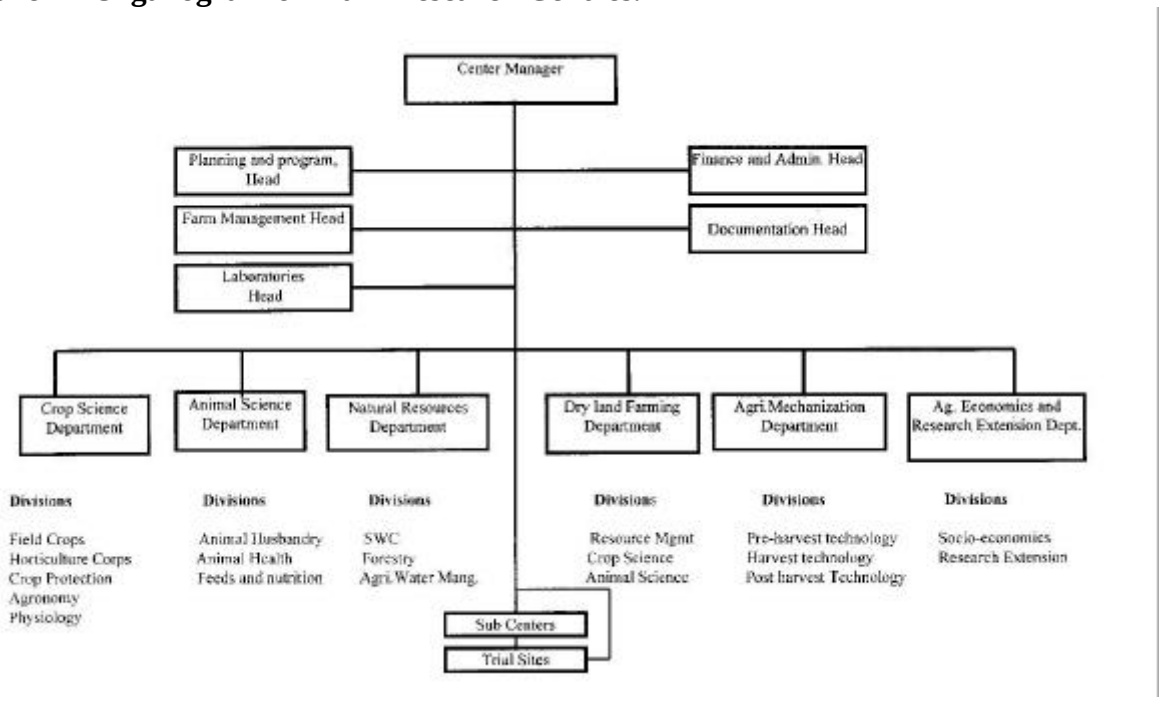
1. Introduction

This paper reviews the changes in agricultural research which have occurred in recent years and explains the situation in which wetland research would be undertaken in Amahar Region in following up this workshop.

Before 1993/94 agricultural research was co-ordinated at a national / federal level by the former Institute for Agricultural Research. In 1993/94 the decentralisation process associated with the formation of the federal state was applied to agricultural research and the region too over responsibility for the operations of:

- 3 research centres at Adet, Sirinka, and Sheno,
- 5 multiplication centres for large ruminants, small ruminants and poultry, and
- 2 rural technology multiplication centres at Combolcha and Bahar Dar (Figure 1).

Figure 1 - Organogram of Main Research Centres.



The Regional Bureau of Agriculture became responsible for the centres and they were managed by a Boards set up by the Bureau and their operations co-ordinated by RARTMCU.

In 2000 a 20 year regional research master plan was developed and approved by the region's executive council with short-term, mid-term and long-term strategies. This led to the establishment, by proclamation No 48/2000, of ARARI (the Amhara Region Agricultural Research Institute) which is responsible for executing the 20 years master plan.
The former Technology Multiplication Centres were also transformed to Research Centres

and Sub-centres and the former Fishery Research and Training Centre was also placed under ARARI.

2. Research Foci

In the past agricultural research was dominated by crop related research and others received little attention. Those which were neglected included:

- natural resources management research
- soil and water conservation
- forestry
- water management
- land use dynamics, land evaluation and tenure policy
- rural technology
- livestock research
- fishery research
- research and extension linkage
- agricultural economics research

This trend has continued to some extent with the new round of 156 research projects in 2000 of which 79% were in the crop science area and only 9% in livestock, 6% in fisheries and 9% in natural resource management.

3. Gaps and Constraints for Agricultural Research

Agricultural research has faced a number of constraints which have had to be overcome in order to ensure the effective development of the natural resources in this region. In the first instance there was a shortage of skilled manpower with sufficient experience to undertake the diverse range of activities which are needed. Secondly, the approach to research has tended to not be based on agro-ecology and so has not recognised the diversity within the region. Thirdly, the link between on farmer research and farmers through the extension service has been poor with poor flows of information in both directions. One result of this has been the failure to identify local specific problems which need research.

Recent re-organisation of the agricultural research in the region has begun to address a number of these problems and offers some lessons for others engaged in agricultural research in other parts of Ethiopia. The organisation of research has been reformed and restructured so that it addresses better the region's needs. The new organisational framework also has a clear strategy which is based on the 20 year master plan which is more problem oriented in its approach. The research-farmer-extension linkage has been strengthened in the new arrangements and an agro-ecological approach to research has been taken. Further there has been an effort to ensure that all areas received equal emphasis, thus getting away from the crop bias.

4. ARARI's interest in Wetland Research

ARARI recognises the importance of wetlands in the ecosystems of the Amhara Regional State. They are the source of many streams and help recharge the region's aquifers. Wetlands are also sources of biodiversity providing habitats for birds and wildlife and providing sites for a range of plants, some of which have medicinal uses. For farmers wetlands are a source of critical forage which is used during the dry season to ensure that livestock survive.

However, in terms of the official approach wetlands are not yet considered as important elements in the region's development. In the land use classification system they are in Class VIII which is currently not suitable for agricultural use. They are being destroyed in different ways as a result of encroachment for cultivation, grazing and construction. They also face severe threats from soil erosion.

In order to start addressing the wetland issue ARARI plans to develop some initial work on wetlands which will focus upon identifying the major aspects of wetlands in the region. The project will be entitled " A preliminary investigation of wetlands in the region". It will be primarily an inventory at a scale of 1:250,000 using satellite images (false colour composites), topographic maps (1:50,000, 1:250,000), and aerial photos to identify the extent and distribution of wetland. It will also involve first hand information from field visits and other studies to assess the current management, use and future potential of wetlands, as well as the nature of the potential threats to the existence of wetlands. Over a three year period it is expected to be able to provide an initial assessment of wetlands in the region and to create a map of their distribution.

Researching on Wetlands in South-western Ethiopia: The Experience of Ethiopian Wetlands Research Programme

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Abstract

The overall objectives of Ethiopian Wetlands Research Programme (EWRP) are to contribute to the sustainable management of wetlands in Illubabor Zone, south-western Ethiopia and contribute towards the knowledge of wetlands in the country. The programme has identified trends in wetland use, as well as socio-economic factors which are influencing the different uses made of wetlands. Environmental impacts which result from drainage have been investigated and analysed and methods for rehabilitating wetlands identified. Local management practices that contribute towards sustainable wetland management in some communities and those which have resulted in degradation were identified and recorded. Traditional institutions that are potentially useful for future resource management and the role of neo-political institutions in resource management were explored. Information dissemination and awareness creation at all levels was undertaken.

1. Introduction

Over the last three years research on the wetlands of south-western Ethiopia was undertaken by the Ethiopian Wetlands Research Programme (EWRP). EWRP was established in 1997 by the University of Huddersfield (HU) (UK) in collaboration with Addis Ababa University (AAU), and with technical support from IUCN's East African Regional Office and the University of East Anglia (UK). The Programme was financed by the European Commission and with additional contributions from HU.

EWRP started its field operations in Illubabor Zone of the Oromia Regional State in April 1997. Since then the Programme has undertaken various types of research into the valley bottom wetlands of that zone, and has undertaken awareness creation with the local communities, GOs and NGOs staff. Currently the Programme has completed its first three years of research activity and is preparing its final research reports for submission to the European Union. The Programme has operated through a Field Office established in Metu, the capital of Illubabor Zone some 600 kms south-west of Addis Ababa.

The overall objective of this first phase of EWRP was:

> "*to contribute to the sustainable management of wetlands in Illubabor Zone, south-western Ethiopia*" (Wood 1996, p9).

There were six specific objectives of this phase. These were to:

- identify the nature, extent and trends in wetland drainage and the use of wetlands,
- assess the ecological impacts of different types of wetland use and drainage, including changes in hydrology, pedology and biodiversity,
- identify and assess the local socio-economic processes which are leading to changing uses of wetlands,

- identify appropriate management practices which will ensure the sustainable use of the wetlands, building on the existing indigenous knowledge where appropriate,
- disseminate understanding of wetland dynamics and sustainable management practices, and support the development of local monitoring and management capacity, and
- contribute material to debates, at national and regional levels in Ethiopia, and more widely, where policies which impact upon wetlands are discussed.

This paper outlines the methodology and research approaches adopted by EWRP to undertake this work and summarises the research findings and outputs achieved under each objectives. Detailed information on the specific areas of research and the results can be obtained either from the Field Office in Metu or the principal researchers.

2. Research Approach of EWRP

A range of different research approaches and techniques were adopted by EWRP in order to undertake the research and fulfil its objectives. The approaches adopted were not new. However, they were synchronised together for the successful investigation of the current wetland situation. This helped achieve a thorough understanding of the overall conditions on the ground relevant to the project's objectives.

The EWRP research approach is distinctive because it tried to bring together researchers from different disciplines and integrate their efforts to arrive at a conclusive output. The research staff were drawn from different disciples such as hydrology, pedology, biodiversity, socio-economics, natural resources and policy, and each had different experience and backgrounds. Detailed case studies, the use of PRA techniques to support scientific work, paying attention to indigenous knowledge, linking the research work with information dissemination and incorporating policy research are some of the points that make EWRP distinctive in its work. Most research on wetlands in the past has not integrated such a wide range of disciplines and the role of local knowledge. As a result EWRP is considered a pioneering project in the region (Howard, 1998 pers. com.).

2.1 Holistic and Integrated View

First and foremost the Programme used a holistic approach to investigate the current situation in relation to wetland use and management in Illubabor Zone. The facts and the underlying causal processes were investigated from different angles and directions to get complete and up-to-date information. The overall context, both environmental and socio-economic, in which the wetlands exist was also studied to ensure that the total picture within which wetland operate was understood.

2.2 Multi- and Inter-Disciplinary Approach

One aspect which makes the EWRP distinctive is the integrated nature of the research work. This has been undertaken by researchers from different disciplines, such as hydrology, pedology, biodiversity, socio-economics, natural resources and policy. Because wetland use and change is the result of complex interaction between and within the human and environmental systems, it was necessary to involve a range of disciplines - a multi-disciplinary approach. Furthermore, attempts have been made to follow an inter-disciplinary approach so that the findings from each discipline are interrogated and discussed with other researchers and an overall synthesis built up.

On the environmental side of the programme there were three activities. These included

hydrological monitoring and analysis, biodiversity assessment and analysis, and pedological analysis. Whilst on the socio-economic side there were also three major activities undertaken, socio-economic surveys, participatory rural appraisal and policy analysis.

2.3 Local Knowledge Perspective

The programme recognised the importance of local knowledge in all aspects of its work. Local communities know their environment better than anyone as they have lived there for generations and have consequently developed an intimate knowledge of their social and environmental circumstances. Through the long-term use of wetlands, a body of local knowledge has evolved within the community which guide's people's use of wetlands and this knowledge was regarded as critical to the research of EWRP.

2.4 Use of PRA and Complementary Field Methods

PRA tools and discussions with the farming community have been used extensively in this research to investigate the wealth of local knowledge that has been accumulated within the communities over the years. These PRA tools have also complemented and supported the formal social science field surveys in the areas of socio-economic research. Even the environmental monitoring work was supplemented with PRA methods in the field to explore local environmental knowledge, management practices and skills. This experience with PRA techniques has shown that they can generate a lot of practical information which has supplemented the scientific knowledge and helped researchers to understand the complex issues related to wetland use and management.

2.5 Use of Core Sites and Zonal Surveys

The programme used two different approaches, detailed case studies and zonal wide surveys. For the detailed scientific monitoring, core sites were selected. These were also used for the socio-economic studies using PRA and other methods. However, a zonal wide survey was taken to understand the overall picture in terms of trends in wetland use and to provide a context within which to fit and interpret the findings from the core sites.

3. Major Achievements by Objective.

3.1 The Nature, Extent and Trends in Wetland Drainage and Use in Illubabor Zone.

Activities undertaken

This objective was addressed by undertaking a survey throughout Illubabor Zone, wereda by wereda, to bring together data from a variety of sources on wetland use and its history. This involved discussions with government staff, acquiring data from current and past reports, discussions with farmers, as well as a series of PRA meetings all of which addressed the issue of the history and influences on land use change, especially wetland use. Within the project's focal area (which includes the core sites), detailed land use mapping was undertaken and digitised, using air photographs from two dates, 1982 and 1996. This provided the context of wetland land use change in the core sites. One Masters student from AAU was supported to undertake his research on land use in wetlands and their catchments, linking this to the socio-economic work.

Major findings

Approximately 1.4% of Illubabor is covered by swamps and marshy wetlands, according to Ministry of Agriculture statistics. If floodplain areas and seasonally flooded grassland are also considered, the estimate of wetland area rises to approximately 4-5% of the total area of the

zone. Out of the total of 375 kebeles found within the eleven weredas of Illubabor, 325 kebeles, some 86%, have wetlands (Afework Hailu, 1998, p27).

Wetlands are a small but significant part of the resource base in Illubabor. Although they only account for less than 5% of the surface area of the zone, they are used by virtually every household in one way or another, directly or indirectly. This is shown by the estimates given in Table 1 which are based on data obtained through PRA activities in the study area and the zonal wide survey.

Table 1 - Wetland Uses and Beneficiaries in Illubabor

Uses	Estimate of Households Benefiting
Social/ceremonial use of reeds	100% (including urban dwellers)
Thatching reeds	85% (for house construction)
Thatching reeds for granary roofing	>50%
Temporary crop guarding huts of reeds	30%
Domestic water from springs	50%
Craft materials	5%
Medicinal plants	100%
Dry season grazing	>30%
Water for stock	>30%
Cultivation	10%

3.2 Ecological Impacts

Environmental monitoring was undertaken in eight wetlands, focusing on the hydrology, biodiversity and pedology. The eight wetlands studied represent different development stages and a summary of these is presented in Table 2.

Table 2 - Study Sites and their Development Stages.

Category	Description	Name of studied wetlands
Pristine (little human interference)	No drainage or crop cultivation on site, natural vegetation, reed harvesting available.	Chebere
Partially cultivated	Some areas undergoing drainage and cultivation, natural vegetation present.	Wangenye and Kowna Chatu
Fully cultivated	Whole wetland under cultivation and drainage.	Bake Chora, Dizi & Supe
Degraded	Previously cultivated and drained but now mostly abandoned, characteristic grassland with occasional natural vegetation.	Hurumu
Rehabilitated	Previously cultivated and drained but exhibiting original natural vegetation	Tulube

Source: Dixon, 1997

In all aspects of the natural environment as well as scientific monitoring, local knowledge has been sought with respect to environmental processes. Besides having one senior researcher for each of these topics, one research student has focused especially on the relationship between hydrological reality and farmer's perceptions and understanding of this.

Hydrology

Monitoring Activities

Weekly measurements of groundwater levels using dipwells located throughout the study wetland sites formed the core activity of the hydrological monitoring programme. In addition, these data were supplemented by weekly measurements of water chemistry (pH and electrical conductivity) and monthly measurements of nitrate and phosphate concentrations. Saturated hydraulic conductivity has also been monitored on several wetlands to determine the rate at which water flows through the wetland soils.

Main findings

The water table in the wetlands is influenced by the hydrological inputs (rainfall and runoff) and the development stage (land use) of the wetland. Seasonally, the water table in most wetlands reaches its peak during the wettest months of July and August and then declines to it's lowest, usually during April or May. In those wetlands which remain mostly undisturbed or undrained, the wetland water table remains high throughout they year, exceeding the surface of the wetland during the wettest months. In these sites the week to week variation in the water table tends to be low in comparison to drained or degraded sites where the water table exhibits a much more flashy and erratic response to hydrological input. The consequences of this are that drained sites offer less capacity to store and regulate water supplies. In addition, the frequent wetting and drying of soils in these wetlands results in the rapid degradation of the soil (Conway and Dixon 2000).

Hydraulic conductivity is higher in the less disturbed sites and the water levels recover instantly when water is removed from a dipwell by suction. In contrast, drained and degraded wetlands demonstrated a wider range of hydraulic conductivity measurements ranging from very slow to rapid, suggesting that the movement and storage of water in these wetlands is difficult to predict. (Conway and Dixon 2000).

Pedology

Activities undertaken

Survey of the soil variations within the wetlands and between the wetlands and uplands were undertaken and samples were analysed in the laboratory. PRA sessions also identified a range of local knowledge relating to soil dynamics and management in the wetlands.

Main Findings

The dominant wetland soils of central Illubabor have been identified as Umbric Gleysols, Gleyic Luvisols and Gleyic Alisols (Asmamaw Legasse, 1998; Belay Tegegne, 1998; Solomon Tekalegn, 1998; Yizelkal Fantahun, 1998). These soils have formed on alluvial sediments that are derived from basaltic rocks on the adjacent slopes. The texture of the soil fraction is generally clay, although the soils also include a considerable presence of silt. All of the wetland soils are salt-free and their reactions were strongly to very strongly acidic. The organic carbon and nitrogen contents are generally high but these show a decline with cultivation. The available phosphorous in these soils is mostly very low.

The local farmers recognise wetland soils as '*cheffe*' after the local name of the predominant type of wetland vegetation. They also classify these soils into those which are either shallow or deep. They also identify two soil horizons within each one of these soil sub units -the '*guracha*' (dark soils) layer constituting the top soil and the '*daleti*' (grey soils) constituting the sub soil. Farmers suggest that the subsoil is inferior in quality and productivity when compared to the topsoil. They also report that the dark colour of the topsoil usually changes in

time with cultivation to a greyish shade reflecting loss in fertility. However, they also point out that loss in productivity of wetland soils does not proceed very far because of the fact that the soils are constantly rejuvenated by the inflow of fertile materials from the adjacent slopes (Belay Tegegne, 1998).

Newly drained and cultivated wetlands are invariably rich in organic matter; in time these soils loose their organic matter content with subsequent loss of productivity and quality. Farmers also burn weeds and crop residues prior to cultivation although this leads in the long-term, to a decline of organic matter. The only other change in soil properties identified after cultivation is an increase in bulk density which reduces water storage.

Biodiversity

Activities Undertaken

The principal activities in the biodiversity survey included the sampling of vegetation in the study wetlands and those elsewhere in Illubabor. In each sample plot, all vascular plant species were recorded and the percentage aerial cover and abundance of each species was estimated. In addition, a bird species survey was undertaken in the core wetland sites and both wetland and non-wetland dependent bird species were recorded. Habitat classification of the seven study wetlands was also undertaken. Using PRA techniques local indigenous knowledge on the use and classification of wetland vegetation was investigated.

Main Findings

A total of ninety-five species were encountered during the inventory of the wetland plants. All plants collected from the wetlands of the study sites were classified into wetland dependent (27), wetland associated (51) and non-wetland species (7) (Zerihun Woldu and Kumelachew Yeshitela, 1999). 72 species of vascular plants, belonging to 28 families, were registered in the seven core wetlands studied in the end-of-wet season sampling. The families *Poaceae* and *Cyperaceae* had the highest number of species present in the wetlands. In contrast, forty-four species of vascular plants belonging to 22 families were recorded from the five core sites studied during the dry season (Zerihun Woldu, 2000).

The study revealed that in relatively pristine wetlands, various wetland dependent plants that have a higher potential for water tolerance are dominant. With long-term drainage and cultivation non-wetland species start to invade the wetland. Cultivation usually results in the removal of the plant species unable to withstand the changes that have been introduced. The general increase in diversity of terrestrial plants reduces the diversity of wetland plant species, replacing them with more common meadow grasses and weeds that are common in cultivated areas.

The effect of grazing and biomass harvesting on habitats and plant species is not as drastic as cultivation. The shift in species composition is gradual. However, the biodiversity study indicates that those wetlands grazed for a long period of time tend to become similar to the degraded and drained wetlands and not like the pristine ones.

A total of 92 species of birds in 40 families were recorded for all sites. Out of the total 48 Afrotropical birds in Ethiopia, 17 (35.4%) species were recorded from the study sites. There were also three endemic and five near-endemic bird species (Tadese, 1999).

3.3 Farm Decision-making and Socio-economic Processes

Activities

A programme of PRA which included 78 sessions and 1091 farmers identified several key issues in all the core study areas. Farmers' perceptions of wetland use and management were explored with particular emphasis on local systems of wetland management and the institutional arrangements and management capacity of local communities.

A conventional questionnaire survey involving 1,120 farm households was also undertaken and the data from this was analysed in conjunction with the results of the PRA programme. The data from each were found to compliment each other.

Major Findings

a) Socio-economic determinants

According to the local farmers wetland cultivation started in the region during the era of *Dejazmach* Geneme (1911-1918) to ensure food availability in the traditionally grain-deficit summer months. During this period market oriented coffee production also started in the zone thereby making it necessary to expand cultivation to wetlands as more and more of the upslope land was taken for coffee (Solomon Mulugeta, 1999). Approximately 20% of wetlands in Illubabor have been cultivated each year between 1986 and 1998 (Afework Hailu, 1998). Maize is the dominant crop grown in the wetlands.

Both the PRA and the questionnaires confirmed that it is mainly the wealthier members of the community who engage in wetland cultivation. It is the economically better off members of the community who are the ones who perform most of the wetland cultivation not only as a result of their "ownership" of wetland holdings, but also due to their ability to deploy adequate labour both for cultivation and for crop guarding (Afework Hailu and Abbot 1998; Afework Haila 1998; Solomon Mulugeta 1999).

b) Local institutions

Four community institutions, that were operating in the past and in some cases are still operating in Illubabor, were identified using PRA tools and case studies. These include, reciprocal labour institutions, socio-cultural / traditional institutions, neo-political institutions and an indigenous community management institutions (Abbot and Afework Hailu, 1999). In addition, reciprocal labour institutions identified during the assessment include 'dado' 'debo' and 'jige'.

Socio-cultural / traditional institutions include the Gada system that the Oromo settlers brought with them from the east 150-200 years ago. The Gada system consists of the Ganda administrative system, with Abba Laga, Abba Ganda, Tulla, Shennie and Eder, each of them having a different role within the community. However, at present the Gadda system is no longer operational in Illubabor but the Tulla and Eder are still popular and respected institutions within the community. In Gechi-Borecha Wereda, there exists a functioning wetland labour-management institution (Wetland Cultivation Co-ordination Committee) which is based on the traditional administrative Abba Laga system which is part of the Gada system.

Neo-political institutions are composed of kebele and shennie, the latter once being part of the Gada system. These institutions currently form part of the government administrative system and are responsible for running the day to day activities within their jurisdiction. In summary some of those institutions that command respect and support from the community are

potentially important for natural resource management and should be supported and encouraged.

3.4 Appropriate Management Technologies

Activities

A thorough investigation was undertaken in collaboration with rural communities and MfM (the Menschen fur Menschen Foundation) both within study sites and more widely to identify practices relating to wetland management. During the study different management practices that are related to resource management were identified, recorded and analysed. The places studied included:

- sites of good management where sustainable use appears to be occurring
- sites of poor management where degradation appears to be occurring
- rehabilitation sites where interventions by MfM has been undertaken to try to regenerate wetlands in degraded areas.

Major Findings

Using local knowledge some communities in Illubabor were found to be successfully managing their wetlands without degradation. This knowledge has evolved within the community over many years and practices have been tried and tested. There is the potential to synthesise such knowledge with the results of the environmental monitoring programme in the development of future extension activities, particularly those focusing on the rehabilitation of degraded wetlands.

3.5 Training and Dissemination of Technologies

The objective of this aspect of EWRP's activity was to "develop capacity within communities, local authorities and development organisations working in Illubabor to address wetland management issues." In reality, because the project's understanding of practices which will achieve sustainable wetland management has been evolving through the project period and no complete and perfect knowledge of this can be achieved in a short period such as three years (Tamene, Tsedale and Moller, 2000)**,** dissemination activities have been more diverse than originally envisaged. In addition, because of the limited national sensitivity to wetlands, the project has also been involved in various types of awareness raising activities, and not just the dissemination of project findings.

However, within the project life the following activities were accomplished in order to disseminate information and build capacity for sustainable wetland management in South-western Ethiopia and through time to contribute to the nation as a whole. These actions have included:

- information dissemination through meetings and workshops,
- research training informally and through training courses and workshops,
- production and circulation of training and extension material,
- presentation of papers and posters in national and international meetings, and
- preparation and publication of research and extension material and its dissemination.

The diverse beneficiaries of these various activities have included over 1,548 farmers, 55 kebele leaders, 157 wereda agricultural staff, 9 zonal officials in a variety of ministries, 18 wereda administrative officials, 11 wereda Ministry of Agriculture mangers and team leaders, 52 regional and national level officials in ministries and agencies, 5 managers and technical

staff amongst NGOs working in the study area. In addition, 12 academic researchers in Ethiopia and Britain, and 60 persons from the international wetland community were involved in a range of dissemination activities (EWRP, 2000).

The overall outcome of the dissemination activities has been:

- improved capacity for wetland management and training within Illubabor and at the national level among a range of beneficiaries from farmers to government officials,
- a higher level of awareness in Ethiopia and internationally about Ethiopia's wetland issues, and
- availability of research, extension and policy briefing materials for use in Illubabor, nationally and internationally.

3.6 Policy

The research undertaken by EWRP has shown that there is little attention given specifically to wetlands in Ethiopian government policies and legislation. The Conservation Strategy of Ethiopia does identify wetlands as an important facet of the environment but generally emphasises the importance of wetlands in terms of the role they play in the functioning of the hydrological cycle. The recent Water Resources Policy only makes mention of wetlands for the biodiversity and water purification reasons. In other words wetlands are small ecological niches which to date have not attracted much attention. Policies are developed for the major ecological niches and their resources, such as forests, agricultural land, and grazing land, but not for those niches which are seen as less important. It is only at lower levels, specifically the community, that there is evidence of policies designed for wetlands. This seems to be increasingly common as pressures on wetland resources increase and by-laws are developed, for instance to protect wetlands for reed production or for cultivation rather than allowing open access for cattle grazing. Similarly some NGOs have identified wetlands as key resources and they have developed policies to support communities using them as an alternative to forest clearance (Wood 1999).

On the other hand, from the various sources used in this research, it is clear that wetlands have been affected indirectly by a range of government policies in this country. In many of these cases it appears to be by chance that the government policies have impacted upon the wetlands. Some of the policies adopted by the Derg government which either directly or indirectly affected wetlands included, the land tenure proclamation, the green revolution, resettlement, villagisation, the surplus producers weredas policy and coffee expansion, whilst the present extension package policy and the wetland task force mission for food security are the others that have direct impact on the wetlands. Further community policies which have had impacts on wetlands management in the past, still do so at present.

4. Threats to Wetlands

In Illubabor the traditional use of wetlands has been for the harvesting of reeds for the roofs of rural houses (*tukuls).* However, there are indications that these wetlands have been used for agricultural purposes since the Menelik II era with increased use through time. Approximately one third of the total valley bottom wetland area identified by the Zonal Department of MoA has been under cultivation for growing food crops at one time or another since the Derg regime (Afework Hailu 1998).

However, the complete drainage of wetlands is leading to a number of ecological and economic problems. Some of these are immediate and clearly linked to drainage, such as the

scarcity of thatching reeds, vegetation change, lowered water tables and reduced access to drinking water (Wood, 1996). Other problems are more complex and long-term, such as declining agricultural productivity, reduced availability of land for "hungry season" crops, increased fluctuations in stream flow, reduced water quality and downstream hydrological impacts.

Planting of eucalyptus, banana, sugar cane, *chatt* on the edges of wetlands and cropping of teff (*Debi*) in wetlands has been identified as a threat for the survival of these areas. There is a strong opinion among farmers that these types of plantings on the edges of wetlands have resulted in the systematic drying-out of these areas.

Grazing by domestic stock has been identified as another threat to wetlands. When continuous cultivation is followed by grazing, wetlands become easily degraded and lose their natural characteristics. Stock trample the soil and compact it, their grazing also destroys the natural vegetation and they erode drainage channels leading to gullying and increased water outflow. These effects often result in the complete degradation of wetlands by reducing the water table and by changing the original vegetation.

5. Conclusions

Although the research work undertaken by the EWRP has been able to generate a wide range of information on some wetlands in the south-western highlands, it is not sufficient to answer all the problems facing the country's wetland resources. Further research work is vital in the wetland field in this and other parts of the country to strengthen what has been done and to add to the body of knowledge already explored. Only then can we come up with findings that can respond to the future challenges that could appear through time.

Furthermore, EWRP's research has focused on the study of valley bottom wetlands, specifically on marsh and swampy wetlands, of highland Illubabor. There is a considerable range and diversity of wetland types in the country and all should be studied in depth.

The approaches and methodology used by EWRP for investigating wetland issues have proved to be effective in meeting the needs of the research work and providing an enormous quantity of information from the scientific aspect and from the local perspective. EWRP is happy to share the experience.

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Development Initiatives and Challenges for Sustainable Resource Management and Livelihood in the Lake Tana Region of Northern Ethiopia [I]

Berhanu Teshale, Dr Ralph Lee and Girma Zawdie

Abstract

Lake Tana, located in north-west Ethiopia, is the second largest freshwater lake in Africa. It accounts for 50 per cent of the total inland water area of Ethiopia and feeds the Blue Nile River, which contributes 85 per cent to the total flow of water in the Nile. The diversity and extent of biological resources in and around the lake have not yet been properly assessed, but the potential of the lake for supporting the development of irrigated agriculture and fishery has long been recognised. The aesthetic value of the lake coupled with the historic monasteries on its islands, have also added to its use value through the development of tourism and the growth of inward investment. However, recent developments in the region around the lake, and particularly in Bahar Dar, a rapidly growing town on the southern shores of the lake, have cast doubt on the sustainability of the use value of the lake. There are indications that the growth of social and economic activities in Bahar Dar and the current practice of discharging untreated industrial, municipal and domestic waste into the lake have adverse effects on the quality of lake water. This poses a potential threat for the sustainability of the growth of Bahar Dar as a regional capital; the sustainability of communities who depend on the lake for their livelihood; and the sustainability of resources in and around the lake. This paper sets in context the issue of environmental management and development in the region, and points out the need for more research to inform policy, so that human interventions can be directed in ways that enhance the sustainability of the aquatic and agro-ecosystems of the region.

1. Introduction

Resource-intensive economic activities often precipitate environmental degradation. This is particularly the case when prevailing production and consumption patterns are unsustainable. In many developing countries and regions, the task of resource planning and management is fragmented. Consequently, resource management decisions are rarely influenced by concern for long term economic growth. Policy is rather swayed by immediate social and economic concerns arising from the prevalence of poverty, unemployment, poor health and education status, and poor housing conditions. However, attempts to stretch the existing resource base to its limit in order to resolve prevailing socio-economic ills have often backfired, giving credence to the view that the persistence of poverty in developing countries is for the most part self-inflicted.

While resources have to be used to meet the current needs of a growing population, it is also important they are used in ways that do not compromise prospects of readily meeting the needs of future generations. In many developing countries, however, policy is predicated on the implicit assumption that the supply of natural resources is infinitely elastic, so that the task of environmental management is seldom considered as a major issue of policy concern.

The view that environmental protection is a red herring for developing countries and poor regions, where the demand is for rapid growth and improvement in living standards, is, however, misconceived. It has been shown in a number of studies[II] that environmental concern is not only compatible with sustainable economic growth but is also a crucial

component of it. The issue of environment and development first found a proper perspective in the Bruntland Report (1987) commissioned by the World Commission on Environment and Development. This provided an important basis for the Rio Earth Summit, which, *inter alia,* came up with Agenda 21, a blueprint for action on the protection and sustainable use of environmental resources at local, national, regional and global levels. Agenda 21 also highlights the need to consider local priorities seriously and to integrate these to national and regional plans of action in ways that promote equity, inclusion, empowerment, integration and partnership objectives. These constitute the building blocks for the development of local initiatives addressing specific local needs and circumstances based on management systems and decision-making processes that are open, transparent and participatory. This approach to development is, however, at variance with the traditional top-down policy and planning practice, which has often proved ineffective in dealing with questions relating to location-specific environmental conditions and the sustainability of the livelihoods of local communities.

While devolving the responsibility for resource planning and management to local communities may be a necessary condition for meeting the objective of sustainable development, it is important - particularly in the case of developing countries - that this is complemented with capacity building initiatives at local and national levels in an integrated framework. Such an arrangement would enable the efficient and effective exploitation of local resources, including local knowledge, to meet the social and economic needs of local communities. It also ensures that economic activities are sustained within the bounds of local environmental constraints. It can be argued, after all, that degradation of environmentally sensitive resources is most likely to happen where local communities are marginalised in the course of the implementation of top-down oriented development initiatives. Such instances of exclusion and marginalisation deprive communities of a sense of ownership and make them prone to environmental neglect. This would blinker their long-term view of the risk that environmental degradation poses to the sustainability of their livelihood. Their objective in such instances would be to maximise survival opportunities irrespective of the cost this would imply for the environment.

This paper is an attempt to set the context for a comprehensive study of the interaction between the demographic, social, economic and environmental components of sustainable development in the Lake Tana Region of north-west Ethiopia. The paper addresses the threat of environmental degradation in the Lake Tana region posed by the rapid growth of economic and social activities in Bahar Dar, a town on the southern shore of the Lake. The immediate threat is to the quality of the lake water and hence to the use value of the lake. This has, however, long term implications for the sustainability of the bio-diversity supported by the Lake; the sustainability of the livelihood of local communities who have traditionally thrived on fishing; and the sustainability of the growth of Bahar Dar as a regional capital and the growth of the regional economy. Not much work has been done along this line for the Lake Tana Region. Nor is a comprehensive data set available to date. The need for a baseline research on the agro-aquatic and wetland ecosystems of the region cannot, therefore, be overemphasised. In what follows, we seek to set the background and the context for such an undertaking.

2. The Lake Tana Region

This is a region in the north-western highlands of Ethiopia experiencing changes in the environmental balance forced partly by climate change, but mostly by the persistence of

unsustainable production and consumption systems. Lake Tana has historically been central to the economic base of the region. The lake has provided an excellent vantage point for the development of an old town, Bahar Dar (literally meaning "sea side"), into a major regional capital, based on the conglomeration of modern economic activities. Questions are, however, asked whether the recent growth of Bahar Dar is in keeping with the sustainable development of region at large. We argue in this paper that the answer to such questions turns on the sustainability of the use value of the Lake, which in turn depends on a whole range of factors, including population growth, the growth of resource-intensive activities, resource management, and possibly also climate change.

2.1 Lake Tana

Lake Tana, situated at an altitude of about 1800 m. above sea level, is a crater lake formed two million years ago due to the volcanic blocking of the Blue Nile River (Figure 1). It is the source of the Blue Nile. It is 78 km long and 67 km wide, and its area of 3150-3500 km^2 constitutes about 50 per cent of the total inland water area of Ethiopia. The mean annual outflow is about 4.km^3 per year, which is about 7 per cent of the total flow of the Blue Nile. It is a shallow lake, with a maximum depth of 14 m and a mean depth 8.9 m. Based on the chemical parameters, its trophic status could be categorised as mesotrophic[III]. Its bottom is volcanic basalt mostly covered with a muddy substratum with only little organic matter (Howell & Allan, 1994). The Bahar Dar Gulf area and Mehal Zegie area is also covered by plant debris.

The main tributaries to the lake are Little Abay, Gumara, Ribb, Magech, Infranz, and Gedla. There are lagoons and wetlands on all sides of the lake resulting from hydrological and land use changes. The Dembea Plain to the north, the Fogera Plain to the east and the Kunzila Plain to the south-west are low areas bordering the lake which are often flooded during the rainy season. This flooding forms extensive wetlands and adds to the large sediment load of the lake. The areas bordering the lake have a dendritic[IV] type of drainage network. The soil loss rate from these areas is 31-50 tonnes/ha/year due to sparse land cover and high rainfall in short period of time. Rocks border the west and north-east of the lake (Nagelkerte, 1997, Wudneh, 1998).

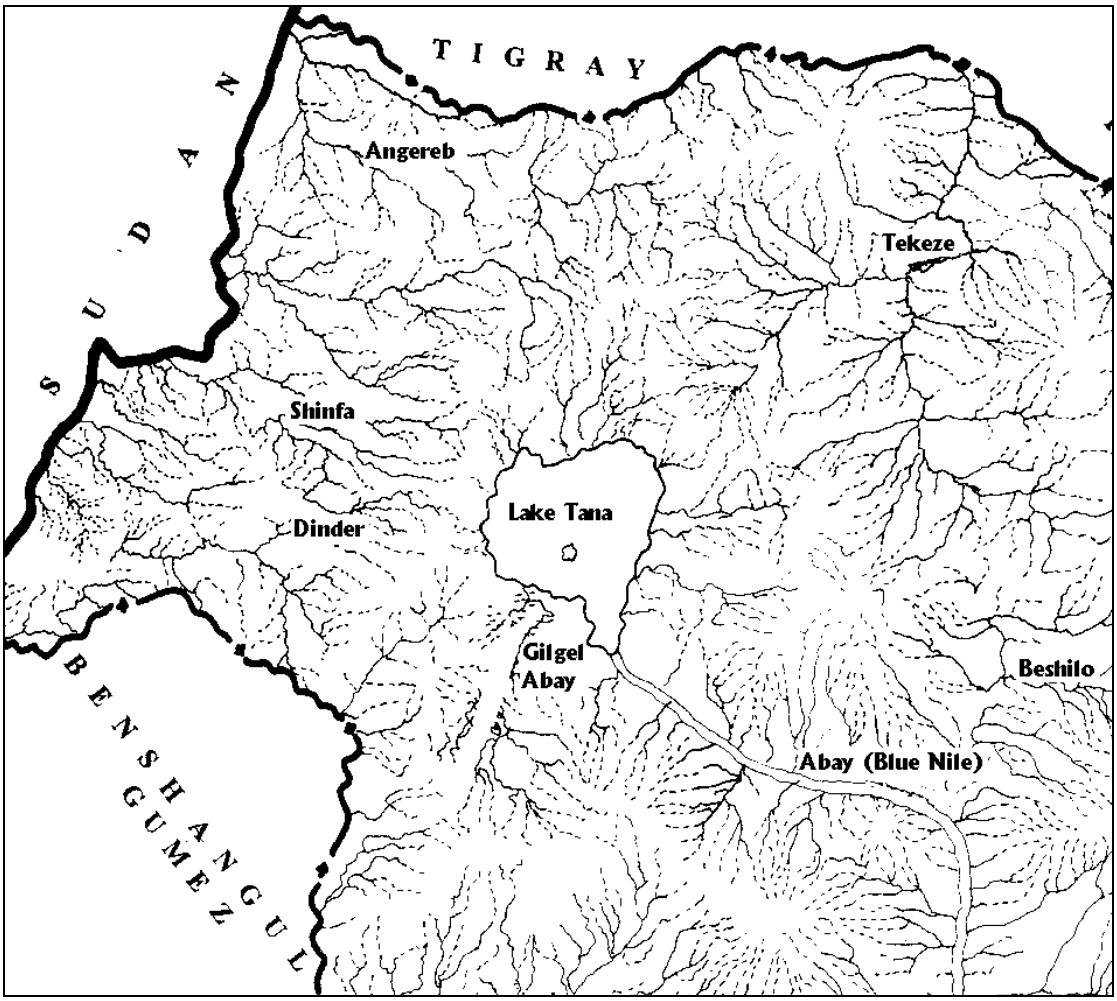
The Lake Tana area has warm temperate climate. The average temperature is 21.7^oC , with a maximum yearly variation of 5^oC. Temperature has two peaks, one around May-June at the start of the rainy season and the other around October-November at the start of the dry winter season. The minimum temperature ranges from 6^0C in December-January to 16^0C in May. The climate is seasonal and is dominated by dry season from October-November until May-June. The rainy season (*kremt)* runs from July through August and September, with the maximum monthly rainfall occurring in July. The mean annual rainfall is about 1500 mm, of which 54 percent falls in the months of July and August, when the rainfall can be 250-300 mm/month.

The seasonal rains cause the lake level to fluctuate regularly with an average difference between the minimum, in May-June, and the maximum, in September-October of about 1.5 m. The largest recorded increase in the lake level was about 2.5 m in 1997. Most of the small rivers dry out shortly after the big rains. Significant inflow comes from three major rivers in the South, namely the Gilgel Abai, Rib, and Gumara which carry a large amount of silt resulting from severe erosion, thereby increasing the turbidity of the water in the Bahar Dar Gulf. The transparency of the Secci disk depth is reduced during rainy season to 37 cm. Due to the shallow saucer-shape of the lake, and the fairly strong winds starting in the

afternoons - becoming stronger after sunset - the transparency for the whole lake ranges from 130 cm during rainy season to 182 cm during dry season (Secchi depth[v]). The transparency of water is also different during the early hours of the day and in the afternoon.

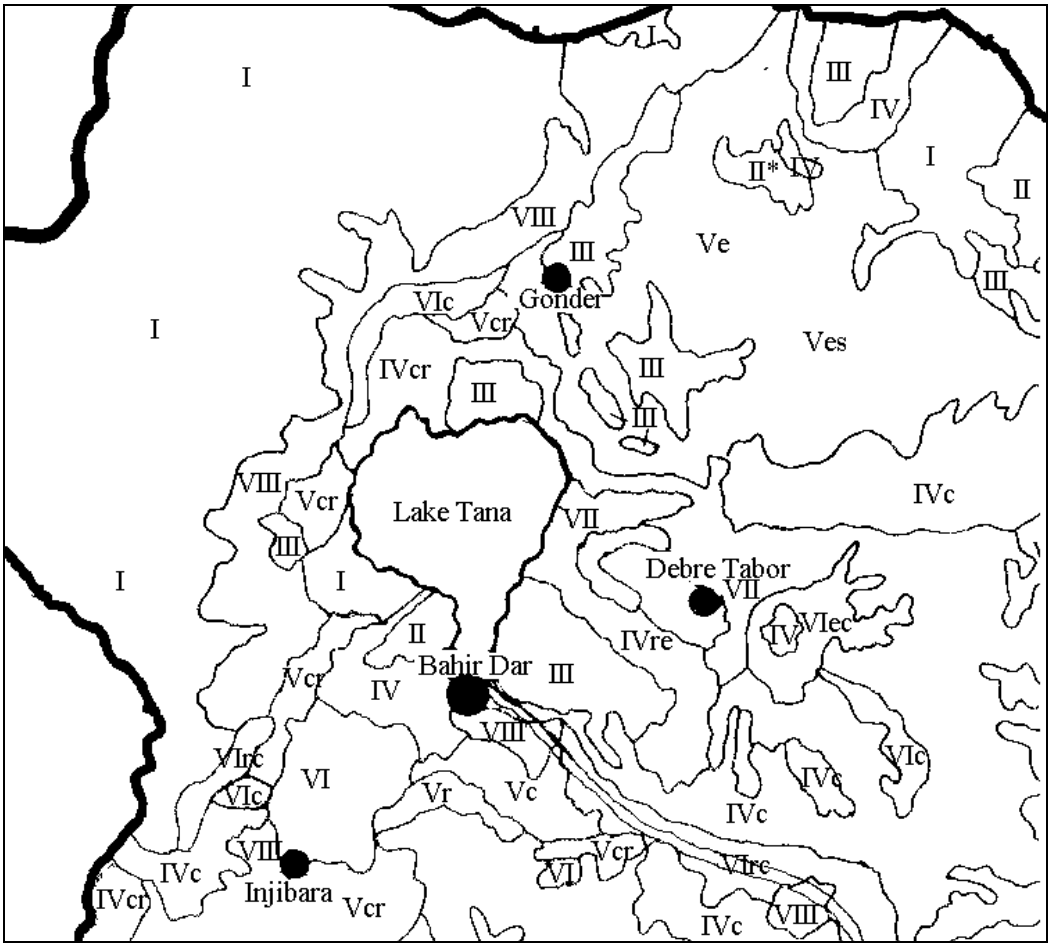
The population distribution is high in those areas to the north, east and south of Lake Tana. The population density is 151-200 persons/km^2 in the north and in some parts of the Fogera plain to the east, and is 101-150 persons/km^2 in the more fertile lowland areas to the east and south-west. There are signs that the rapidly growing population in the region is placing increasing pressure on the carrying capacity of the land. This coupled with the persistence of the age-old agricultural mode of production has been responsible for deforestation and soil degradation over the years. Figures 1-3 show the drainage, soil loss rates, and population density respectively, as well as the location of Bahar Dar, to the south of the Lake.

Figure 1 - Drainage around Lake Tana (Source: Ethiopian Mapping Authority, 1997).



Lake Tana feeds the Blue Nile, which in turn provides 85 per cent of the water supply to Sudan and Egypt through the Nile (Howell & Allan, 1994). It also provides some of the water supply for Bahar Dar, and is a significant source of water supply for the rural population around the lake. It is, however, also now used as a sink for dumping industrial, municipal and domestic waste from Bahar Dar. Solid waste and effluent discharges from homes, hotels and factories pass untreated into the lake. This process of pollution is assisted by the urban runoffs, which are heavy during the rainy season.

Figure 2: Soil Loss Rates around LakeTana (source, Ethiopian Ministry of Agriculture, 1984). (Rates are expected to have increased by up to 30% since these measurements were taken.)



Key

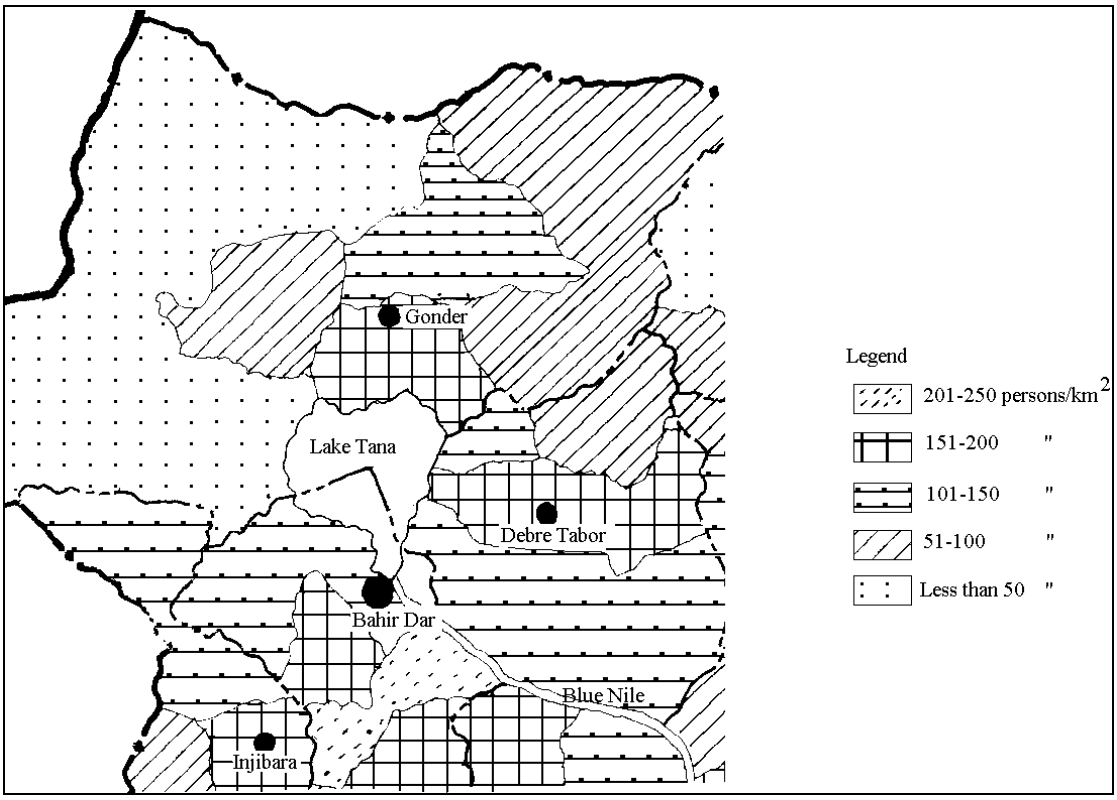
Class	Tons/ha/year	Mm/year
I	0-5	0.0.5
II	6-15	0.5-10
III	16-30	10-25
IV	31-50	25-40
V	51-100	40-85
VI	101-200	86-165
VII	201-300	165-250
VIII	>300	>250

Notes:

I & II	none to light erosion
III & IV	moderate erosion
V & VI	high erosion
VII & VIII	very high erosion
s:	soil loss mainly due to steep slopes
e:	Soil loss mainly due to high erodability
c:	Soil loss mainly due to high corodability
R:	Soil loss mainly due to high rainfall
*:	Dense vegetation cover

The lake receives sediments of alluvial soil from incoming rivers, which flow past areas of intensive agriculture and deforestation, particularly along the eastern and northern parts of the lake. The use of fertilisers and pesticides is increasing in the areas bordering the lake. These are washed into the lake by heavy run-off, and have serious consequences for the quality of water in the lake and the use value of the lake. The lake is a source of fish, although the significance of this has not been fully realised yet. Moreover, it has significant potential as a

Figure 3: Population Density around Lake Tana (source, Amhara Regional State, Population Unit).



source of irrigation water. Also, the usefulness of the lake as a point of tourist attraction cannot be underestimated.

The strategic significance of Lake Tana for the region as a major economic and environmental resource is thus apparent, as is the need for the development of a comprehensive environmental management system to ensure the conservation and sustainable use of this resource. The concern now is that the rapid growth of Bahar Dar on the southern shore of the Lake is posing a major threat for the sustainability of the use value of the Lake.

2.2 Bahar Dar

At the southern end of the lake is a relatively stagnant gulf area where the town of Bahar Dar is located. There has been a settlement at or around Bahar Dar for many centuries, but the economic growth of the town began in earnest in the 1950s, when its status was raised to a regional capital. Bahar Dar has been the regional capital and economic centre for north-western Ethiopia since 1958, when German experts prepared a comprehensive master plan for its development. Bahar Dar was made the capital of Western Gojam Administrative Region in 1987, and since 1991 has been the capital city of the Amhara National Regional State. The population of the city has grown rapidly in recent years and was estimated at around 113,000 in 1998, on a built up area of 900 hectares. Investment in hotels and factories is growing too. Currently Bahar Dar has two large factories, namely the Bahar Dar Edible Oil Factory, and the Bahar Dar Textile Mill, and three tanneries are under construction. The expansion of the town has created opportunities for construction and related businesses (Asefa, 1998).

2.3 The Environmental Condition of the Lake Tana Region

The most recent limnological studies of the lake were carried out in the 1940s, but these did not include proper temporal and spatial analysis. They thus provide little data of significance for understanding current issues. We can say, therefore, that there is to date no environmental survey of Lake Tana, and the region around it, including the pattern of land use and the implications of agricultural and industrial practices for the quality of the lake water and the aquatic biodiversity associated with the lake. Currently there are only qualitative assessments of what is happening to the lake; and what little there is by way of evidence suggests that the ecosystem of the gulf region of the lake, where Bahar Dar is situated, is changing significantly.

Whilst most of the land around the lake is used for agricultural purposes, Bahar Dar and its surroundings have become the focus of industrial, urban, and tourism development. The amount of waste being discharged directly into the lake by activities in and around Bahar Dar is increasing. This is posing increasing threat even to that part of the Lake adjacent to Bahar Dar which has for long been protected, even during the rainy season, from the inflow of waste and effluent discharges. But with the growing level of activities in and around Bahar Dar and the increasing pressure of demand for waste disposal, waste discharges of varying toxicity and chemical composition have found their way into the lake, thus polluting even the once nascent part of the lake adjacent to Bahar Dar. This process of dumping untreated waste into the lake will, if unchecked, diminish the use value of the lake and dim prospects for the growth of tourism on which the city of Bahar Dar has put so much hope for its growth.

The disposal of waste into the lake has also the effect of undermining fishery development, thus threatening the sustainability of the livelihood of local fishermen. Local fishermen are finding it increasingly difficult to fish along the shores of the lake as they used to do in the past, and they are forced to sail in their *tanquas* (boats made of papyrus) further into the middle of the Lake. This, however, takes them longer without improving their catch rate. Moreover, use of the *tanquas* for fishing in the middle of the lake simply increases the risk to their safety, thus aggravating the precariousness of their livelihood.

The local fishermen recall that in the past, the gulf area, which is undisturbed by the current of the Blue Nile, was relatively clear even during the rainy season. At present, the gulf area around Bahar Dar appears to have high levels of silt and waste, most of which originates from activities in Bahar Dar and from the numerous construction sites around the town. Climate change factors could possibly have a role in this. Due to the high winds that build up during the day, and the shallowness of the lake, wave action stirs up the silt and waste deposits, and the lake appears muddy in colour particularly during the afternoons. This has implications, *inter alia*, for changes in the stock of the population of fish in the lake.

Tropical shallow lakes are, in general, highly productive of fish. The potential fish production of Lake Tana is estimated by the Ministry of Agriculture to be 13,000 tonnes per annum. Until the last couple of years, production was about 1000 tonnes per annum. However, this has dropped by about 50 per cent in recent years to 600 tonnes in1999 and 500 tonnes in 2000 (MOA, personal communication).

The reason for this fall in catch is not clearly understood, but it could be due to both market and environmental factors. The falling price of meat locally may have contributed to a fall in demand for fish. Local fishermen, however, now travel much further to fish, as they cannot find the much-desired *telapia* around the Bahar Dar gulf area. The drop in catch is associated

with an increase in effort per unit of catch, suggesting falling fish stocks in the lake consequent upon environmental changes.

Fish breeding generally takes place in the vegetated areas around the edge of the lake. However, excess sediment loading is known to make it more and more difficult for fish species like *telapia* to breed. There is good reason to believe that the sediment arising from construction activities in Bahar Dar may be contributing to a fall in fish stock.

The growth of rooted macrophytes in the south of the lake, close to the town of Bahar Dar, is interfering with water recreation activities. Brown mud sediment combined with alkalinity greater than 50 mg/l as $CaCO_3$ favour macrophyte diversity and abundance. The water in Lake Tana is moderately alkaline and excess sediment arising from construction and agricultural activities in and around Bahar Dar enhance the increase in macrophyte growth. Because rooted macrophytes obtain most of their nutrient demand from the sediment, their tissue phosphorus and nitrogen content is important to the nutrient economy of the lake. Lake ageing is more sensitive to internal phosphorous recycling via rooted macrophytes than to external sediment and nutrient input. Because the lake is mesotropic, one fear is that increases in phosphorus levels in the lake could lead to eutrophication. Local fishermen think that the growth of certain weeds is increasing in the gulf region of the lake.

The eastern and southern shores of Lake Tana are covered with swamps and wetlands, especially near river mouths, dominated by papyrus. The area covered by papyrus has, however, decreased recently, while the area covered by other rooted plants and floating weeds has increased. The growth in the level of industrialisation and economic activities in and around Bahar Dar also appears to have aggravated the toxification of the lake. There is little documented evidence of this at the moment, but the problem is apparent in view of the discharge of untreated wastes into the lake.

Pollution of the lake, whether by industry, urban settlement, or agricultural practices, has serious implications for the development of the region as a whole. For many years, food production in the area has been seriously constrained. One strategy for increasing agricultural production in the region is irrigation using mainly the fresh water from the lake, as many rivers dry up during the dry season. The lake, if polluted, may, however, be unsuitable for this purpose. Nor would it be able to support a growing fish population. Moreover, pollution would make the lake unattractive as a tourist site.

3. Discussion

It is apparent from the points raised in the above discussion that Lake Tana and the region around it are experiencing changing environmental conditions consequent upon growing population size and the persistence of unsustainable patterns of production and consumption. Climate change is also a possible factor affecting environmental conditions of the region, but its significance in this respect has not been examined and documented yet.

The increased sedimentation of the lake and the falling fish catch rates reported by local fishermen broadly indicate that the region is experiencing environmental changes which could have adverse consequences for the sustainability of the regional economy. Understanding the mechanism which precipitates adverse effects on the sustainability of the environment in the region will, as noted above, call for a close look into the significance of such factors as climate change, population growth and prevailing patterns of socio-economic activities.

The pollution of the freshwater lake and the risk this poses for the sustainability of the use value of the lake means it is high time regional development is approached in the spirit of Agenda 21 through integrated planning and management of resources in and around the lake. There is, however, little or nothing at present by way of research to inform planning and management decisions and the translation of Agenda 21 into action at regional level.

The limited growth of economic activities in the region, and particularly those centred in and around Bahar Dar, has created modern employment opportunities and has brought about improvements in living standards for some. The question, however, is whether expansion of modern activities at the present rate and state could be expected to generate economic gains that are capable of benefiting the vast majority of the population in the region on a sustainable basis. There is little to inspire confidence in this respect. Anecdotal cases relating to the conditions of local fishermen appear to suggest that the sustainability of the livelihood these fishermen and their communities is inversely related to the expansion of modern activities in Bahar Dar. Whether this is a matter of spurious correlation is a question which has yet to be put to the test. What is, however, unequivocally clear is that local fishermen are being increasingly marginalised as a result of the present trend of environmental change in the lake region. And yet, there has, to date, been no comprehensive assessment of the costs and benefits of what has taken place in Bahar Dar in recent years.

If the northern part of Ethiopia is to experience sustainable economic growth through agricultural development, industrialisation, and increasing tourist turnover, it is imperative that the implication of these for the water quality of Lake Tana is clearly understood. One has only to look at Lake Victoria and the increasing problems it now faces with massive growth of water hyacinth, which covers a good part of its area, and the consequent threat of eutrophication to see the implications of similar developments in the case of Lake Tana.

A unique opportunity, however, presents itself in the case of Lake Tana, where a comprehensive management strategy could be established before the Lake suffers serious environmental degradation. On the other hand, planners might find it expedient to use the lake as a sink for dumping untreated municipal and industrial waste. But by so doing, they would preclude options for the long-term development of the region. There is thus a large opportunity cost to planning processes that are poorly informed, lack transparency, are scarcely participatory and are not based on an integrated approach to resource management.

The authors have embarked on a baseline study of the lake, with the view to generating data against which the consequences of environmental changes in the region can be evaluated. The first task of this project is to establish the major factors behind the pollution of the lake and the degradation of resources in the region around it. This will bring into focus issues relating to climate change, and evolving demographic, social and economic patterns in the region. Studies on how these impact on the sustainability of the environment will inform policy as to how socio-economic activities in the region can be managed with the view to translating Agenda 21 into action at local or regional level.

4. Relevance to Wetlands

The focus of this paper has been on Lake Tana. An integral part of that ecosystem is the wetland areas around the edge of the lakes which as has been mentioned are important for the breeding of fish. Hence alteration of these areas can affect the whole dynamic of the Lake's

ecology. But the lake margin wetlands are also important for the filtering of sediments which come into the lake and even for the purification of waste waters. It is now recognised that wetlands play critical roles in water purification, fixing many pollutants and also holding sediment. Indeed in some places wetlands are being created to treat the effluent for industrial processes before they are discharged into rivers. Hence there may well be a case for creating more wetlands around Bahar Dar in order to cope with the increased pollution.

The other area of wetland linkage to the Lake Tana system is in the surrounding uplands. Again it is the sediment holding properties of wetlands which could be important in helping reduce sediment inflow to the lake. The protection and re-establishment of wetlands in the valley bottoms in the areas surrounding Lake Tana will help to reduce the sediment load reaching the lake and also reduce peak flow and floods in those river systems. Such wetlands are critical for groundwater recharge and this is important in terms of drinking water supplies and maintaining the water table for permanent crops.

Overall it should be noted that the improved management of the Lake Tana system will have to include the surrounding areas as this paper points out, and in those areas wetlands are one critical element which must not be neglected.

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Footnotes

[I] This paper was originally presented at the Second National Seminar on Sustainable Development and Appropriate Technology, Bahar Dar University, November 10th -11th, 2000

[II] For a list of references on this issue, see Zawdie and Lee (1998).

[III] A lake that is intermediate between oligotrophic and eutrophic is known as mesotropic. An oligotrophic lake has low productivity due to a severely limited supply of nutrients to support algal growth. Eutrophic lakes have high productivity because of an abundant supply of algal nutrients.

[IV] A drainage classification based on the Horton-Strahler method. In this method each headwater or tributary is designated as the first order. Two first order tributaries combine to produce a second order stream, two second combine to produce a third, etc. Dendritic drainage is the type seen in the figure 1.

[V] The depth of the euphotic zone (the upper layer of water which sunlight can penetrate) is measured with a simple device called a Secchi disk. The disk is lowered into the water, until the observer can no longer distinguish the boundaries between the black and white quadrants on the disk. The measure depth is called the Secchi depth.

Lake Tana: Darwin's Ethiopian Dreampound? A future of biodiversity conservation and sustainable use?

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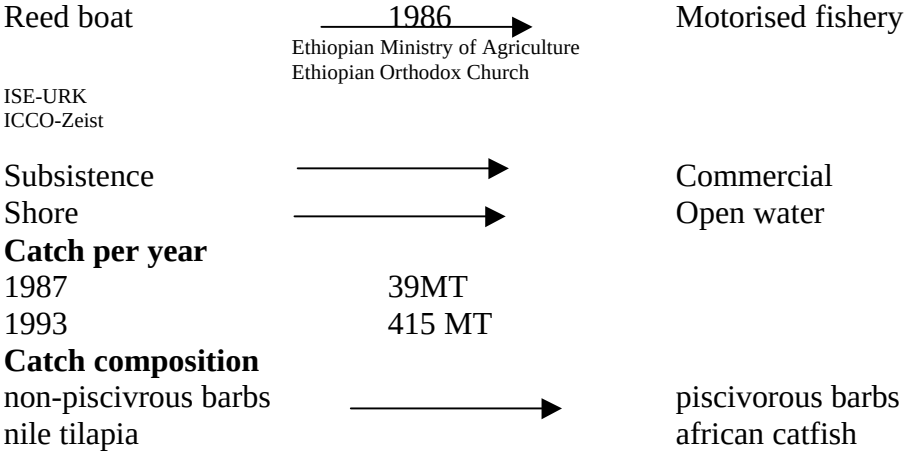
1. Introduction

Lake Tana is located in north-west Ethiopia at an altitude of 1830m above sea level. It is the source of the Blue Nile and is separated from lower Blue Nile Basin by a 40m high waterfall. The lake has an area of 3000 km^2 and has an average depth of 8m and a maximum depth of 14m. It is estimated to be around two million years old.

2. Development of the Lake Tana Fisheries

The development of the fisheries on Lake Tana can be summarised by the following diagram. This shows the way in which motorised commercial fishing with gill nets has developed since the mid 1980s and how the subsistence and commercial fisheries have different characteristics.

Figure 1: Schematic Summary of the Development of the Lake Tana Fishery



The impact of this development on the fish stock can be seen in the following table which provides the available data for fish catches during the mid 1990s.

Table 1: Fish Catches from Lake Tana (tonnes / year)

Year	Catch
1993	400
1994	450
1995	890
1996	1500
1997	1420

3. Impacts of Fishery Development

There have been a number of important studies on the Lake Tana fishery which have tried to address the impact of fishery development on the fish stock in the lake. These are summarised below before some conclusions are drawn.

3.1 Biology and Management of Fish Stocks in Bahar Dar Gulf, Lake Tana, Ethiopia

This study by Dr Tesfaye Wundneh, which was published in 1998 had the following aim:

1) to characterise the spatial and dynamical aspects of community,
2) to define the current of fishery and identify its impact on the fish community, and
3) to identify and assess the options for management in view of the potential production of the fish stocks in the lakes.

Its methods included:

- experimental trawl program, spatial/temporal distribution patterns,
- assessment of the reproduction biology *O. niloticus*, *C. gariepinus*, *B. tsanensis*,
- diet analyses of *C. gariepinus*,
- estimation of the growth/mortality of fish using hard structures,
- assessment of the selectivity of the impact of the gillnet fishery, and
- monitoring catches commercial (reed/motor) fisheries.

3.2 The Barbs of Lake Tana, Ethiopia. Morphology Diversity and its Implications for Taxonomy, Trophic Resources and Fisheries.

This paper by Dr L.A.J. Nagelkerke, and published in 1997 aimed to make an assessment of the Barbus biodiversity. In order to achieve this it analysed the lake's morphology, the food niches for the Barbus sp, their spawning practices and their genetic identity.

The conclusions were that:

- Barbus morphs are a good biological species, composing a unique species stock,
- The species stock most likely evolved in Lake Tana from an ancestral riverine
- benthivorous barb species resembling B. intermedius commonly found in Ethiopia highlands,
- Trophic specialisation was the driving force in the adaptive process,
- Each Barbus morph is a different fish stock and so there is a need for multi-species management towards sustainable fisheries and
- There is a need to establish a catch-effort data recording system.

4. Conclusions:

A 1990-1993 baseline study provides a starting point for analysis of the recent experience of the fisheries on Lake Tana. In the early 1990s it could be noted that there were:

- dynamics patterns and size-related, spatial and temporal distributions of the fish,
- dominant species were *B. tsanensis, B. platydorus, O. niloticus, C. gariepinus*
- temporal and spatial patterns in the gillent fishery could be established for *C. gariepinus, O. niloticus* and *Barbus* spp.

The increased landings between 1993 and 1997 have had a major impact on the state of fish stocks and the fishery with a major collapse in the Barbus spp. This is made worse by the absence of enforcement of fisheries regulations. This suggests the need for a major effort to better manage the fisheries of Lake Tana.

Fishery Resources in Lake Tana: Part I

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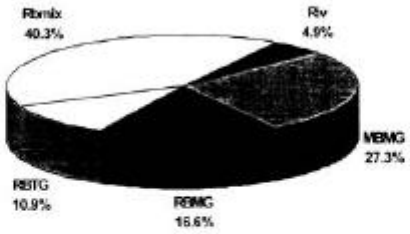
1. Introduction

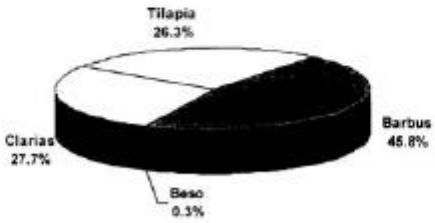
The following tables provide some basic information about the Lake Tana fish resources and their exploitation.

Current Status **(based on 1998/99 data)**

Fishing: Traditional (Reed Boat) fishery 68 %
Motorized boat fishery 27 %
Riverine fishery (only Gumara) 5 %



The catch and effort



Total annual effort = ***196,282 net-days***

The Lake Tana total catch has varied between an estimated value of 320 tonnes in 1983/84 to 1450 tonnes in 1996/97. Since 1996/97 the annual catch has steadily decreased to a level of 800 tonnes at 1998/99.

2. Future Possibilities

There is a danger that Lake Tana will become a low productivity fishery and its fish resources will be poorly known. However, with some effort it should be possible to achieve:

- sustainable fish production (big barbs, catfish and tilapia) in the natural waters,
- fish farming (tilapia, carp, catfish) in ponds and dams, and
- international centre for evolutionary science studies and for tourist attraction (based on the unique barb fauna).

The challenges to achieve this are

- controlling dangerous fishing techniques,
- very low fishing effort supply
- lower market price for fish
- "Development" in agriculture, health, etc

Among government officials it is necessary to:

- give more attention to Lake Tana and its fishery,
- organise a fisheries monitoring program,
- develop a regional fishery policy and regulations,
- reduce the frequent displacement of trained staff,
- achieve greater self-reliance in research and training.

Part II: The Forgotten Fish Fauna in the Fogera Plains

1. Introduction

The Fogera Plains are found on the eastern side of Lake Tana, in Libo Kemkem, Fogera and Dera Weredas of South Gondar Zone. This is a vast, swampy (seasonally water flooded) plain in the area, which is thought to have formerly been a part of Lake Tana (extending up to Tanqua Mariam). The area is especially used for raising the Fogera breed of cattle (and also sheep) which involves a certain degree of nomadic type movement. The Fogera Plains are also known for farming crops on the newly inundated lands (Bahre-shesh) and has also recently been used for rice cultivation.

2. Water Sources

The flooding of the Fogera Plains is caused by the overflowing, during the main rainy season (Kiremt), of the Reb and Gumara Rivers and also R'za and many other streams. This water stays in the plain from July to December. During the dry season (Bega) only isolated patches of water (such as Shesher and Welala ponds) remain in the plain. The rivers that flow through this area carry fertile soil eroded from the Debre Tabor area (highlands to the east). This makes their waters very murky and lead to heavy sedimentation on the plain and the lake shore. This sedimentation process has formed peninsulas of more than 5kms length at the mouths of the major rivers in only a few decades. All the rivers have a gentle gradient and so do not flow at a high speed. As a result the stream beds are also suffering from sedimentation and have a mostly muddy/sandy substratum. There is no trace of rock, nor a single stone, on the Foerga Plains except in the shore side monastery.

3. Wildlife and Vegatation

- on the Fogera plains one can find some mammals (hippos, foxes, highlander hyenas, rabbits and other rodents),
- many kinds of birds in large numbers (including migratory species): *Shimela*, *Yibra*, *Jiba-Jibo*, *Gergeso (*pelicans), *Qerqero*, *Ebab wach*, Eagles,
- reptiles (the biggest being monitor lizard) and amphibians,
- fishes (barbs, tilapia, catfish), and
- also different plants (ranging from the microscopic phytoplankton to the big macrophytes).

4. The Fish and the Fishery

Among the big fish, the barbs (*Barbus spp.*) live especially in the main waters (the lake and its rivers), tilapia (*Oreochromis niloticus*) in the lake and the African catfish (*Clarias gariepinus*) almost everywhere. Some fish remain isolated in the ponds until the next *Kiremt* (many seasons). The catfish invade the plain following the overflowing of Reb River starting from (as the local people tell and from pers. obs.) "*Hamle Abo*" (12th July) every year. Many catfish remain dead and become spoiled out on the land when the temporarily rising water retreats after some hours or days. Big catfish (up to 20 and 25 kg, and 1.5m long) are caught by spear fishing during the night (before the flood level increases). Also fish traps (*Qefo, Angafra*) and some hook and lines are used for fishing. Big whole catfish individually cost from Birr 5.00 to 10.00, and dried ones (Quanta) were sold for Birr 5.00 per kg in Woreta market until 1997. The benefits of these fish are,

- as a good source of food (fresh in Kiremt and dried for Bega) and
- generates income (at a lower level).

5. Research

No separate and specific research has been undertaken on the fish in the Forgera Plains. Only preliminary observations and measurements have been made on the morphometry of Shesher and Welala ponds and their fish during the dry season about five years ago.
Hence there is a need for research into;

- which fish, wholly or partially, depend on the plain for their life,
- why the catfish migrate (seasonally): feeding, reproduction, etc,
- how large is the catfish stock and what is their spatial and temporal distribution
- what production and utilisation strategy should be developed,
  . when: seasonally or year round
  . where: from lake, rivers or the flood plain
  . how: by artificial farming or from the natural stock
  . by whom: local people (traditionally) or investors (modern ways)

Such action could improve the commercial value (market price) of catfish in the area. (What relationships do agricultural and human health activities have with these migratory fish?)

Environmental Impact Assessment on Lake Tana Fisheries

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1. Introduction

Lake Tana, the source of the Blue Nile, is the largest lake in Ethiopia. It probably was formed during the late Pliocene or early Pliestocene times by volcanic blockage of the Blue Nile River. It now covers an area of about 3150 km^2 and has an average depth of 8m, with a maximum of 14m. It is estimated at an altitude of 1830m absl and can be classified as an oligo-mesotrophic lake. Several rivers, for instance Gilgel Abay, Rib, Gumara, Gelda and others join the lake, the Blue Nile being the only outflow. After 30km this river plunges down a 40-meter-high waterfall, isolating Lake Tana and its tributaries from other parts of the Nile Basin.

Four fish species dominate the commercial and artisanal fishery: Tilapia (*Oreochromis niloticus*), catfish (*Clarias gariepinus*), the various *Barbus* species (Nagelkerke, 1997), and to some extent *Varicorhinus beso*. The fishery of Lake Tana is expanding through the introduction of modern technology such as the motorised boat fishery with 100m gill net. Traditional fishing activity is also growing as provision of modern gill nets is increasing for small-scale fisheries. Thus fishing is becoming more important both economically and socially especially for the low-income rural population around the lake.

The information on the introduced exotic fish species in the lake is limited. Two fishery development projects: the Lake Tana Small Scale Fisheries Development Project and the EU supported Lake Fisheries Development Project (LFDP) have been established to address the limited the development of modern fishery in the past.

2. Environmental Impact Assessment Project

The research project proposed here uses the Environmental Impact Assessment (EIA) technique that serves as a tool for assessing, estimating, predicting and communicating the environmental effects of proposed policies, development plans and investment projects in relation to the Lake Tana aquatic ecosystem. In the absence of the EIA the conflicting use of the Lake Tana resources system for various benefits can be detrimental to the fisheries of the lake in particular and for the aquatic resources in general.

3. Project Method

1. Describing the existing environment/physical, biological, social economic and others/
2. Describing and quantifying the existing threats, risks and impacts
3. Determine opportunities and means for reduction in threats, risks and impacts
4. Identify and assess alternative options for control of threats, risks and impacts.

4. Background and Justification

It appears that most inland capture fisheries are currently being exploited at close to or above, their sustainable levels, although catches will vary from seasons, reflecting the qualitative and

quantitative fluctuations of the target population. These natural fluctuations result from changing climatic conditions and the complex population dynamics of interacting groups of organisms. This lack of stability is particularly obvious in tropical inland fisheries, which typically exploit mixed species groups (Dunne et al 1996).

The character of aquatic resources and the hydrologic regime of a river or lake basin is determined by natural factors such as climatic, geomorphology and geology, and vegetation cover. However, the totality of human activities exerts a complex pressure on living and nonliving aquatic resources.

Aquatic environments are increasingly subject to effects of water abstraction and diversion, aquatic pollution and physical modifications of aquatic habitats. Water bodies are being utilised as sinks for waste substances or are recipients of impacts stemming from land-use activities which may be present in watershed areas supplying water to rivers, lakes and eventually the sea.

The impact of above factors is not only on the quality these waters, which change in terms of their physico-chemical characteristics, but other important compounds in aquatic ecosystems are affected such as the organisms and the substrates and sediments of rivers and lakes. Human interventions including fisheries, also affect the structure and function of aquatic communities and habitats. In short, aquatic ecosystems have to assimilate the consequences of ecological alteration resulting from chemical inputs, physical modifications and direct biological interventions due to land and water uses in their watershed areas.

The physical modifications include;

1. Watershed land use change (deforestation, urbanisation, agricultural development, land drainage, flood protection);
2. Corridor engineering (removal of riparian vegetation, wetland change flow regulation via dams and weirs channelisation etc)
3. In-stream impacts (chemical and thermal pollution, water abstraction, navigation, exploitation of native species and introduction of exotic species).
4. Deforestation in the drainage basin of the aquatic ecosystem which usually enhances the rate of water and sediment delivery to the water course, increasing high and low flow conditions temporal variation of biotic factors and often degrading water stream habitat quality.
5. Overgrazing in riparian corridors due to high cattle population, these may degrade streamside vegetation, particularly ground cover and cause soil compaction and erosion of river banks leading to nutrients and soil inputs.
6. Suspended solids directly interfere with light penetration and may reduce the depth to which phytoplankton can develop or shade out aquatic macrophytes, resulting in reduced plant biomass and the availability of shelter and food for aquatic biota.

These changes have major impacts on biological systems, including increased autotrophic production, disruption of invertebrates and fish reproductive cycles and increased juvenile mortality due to loss of habitat, shelter and exposure when water levels fluctuate rapidly.

Eutrophication is increasing in many lakes and reservoirs because of high inputs of nitrogen and phosporous.

Kira (1993) summarised the most widespread environmental disruptions in the world’s lakes

a) lowering of lakes due to overuse of water;
b) rapid siltation of caused by accelerated soil erosion in watershed;
c) acidification of lake water due to acid precipitation;
d) concentration with toxic chemicals;
e) eutrophication; etc

The impacts of inland fisheries and aquaculture play great role in the environment. The introduction of exotic species and genetically modified organisms in particular fish species with good characteristics for aquaculture and stocking and good marketability have been and will continue to be introduced to new habitats. However, introduced species and genetically modified organisms may alter and impoverish local aquatic biodiversity and genetic resources as they affect endemic species via competition, predation, destruction of habitats, transmission of parasites and diseases, inter-specific breeding (Welcomme, 1998).

In the Ethiopian fisheries context, some environmental factors have been identified. Although the consequential effects of these environmental impacts are not quantified in magnitude the potential indications can be used as early warning to develop an awareness of the problem. The major source of pollutants affecting Ethiopian lakes and rivers emanate from factories, agriculture practices and urban population centres and mining.

Different activities intended for deployment in aquatic ecosystems in general and the Lake Tana fisheries in particular require environmental impact assessment on various values. As stated by Miheret, (1997) the need to quantify their impacts (be it negative or positive) on the basis of economical, social, environmental, political, ecological, and institutional is essential.

The negative impact of any human activity on the environment in general and on the aquatic environment in particular, is at minimised level when basic information on the various values mentioned is available and taken into consideration. To accomplish such activities adequate environmental base line information and multi-disciplinary institutional co-operation, adaptive and integrated planning system and flexible management that helps to develop a sustainable resource use should be in place.

5. Methodology

A. Data Collection

- primary and secondary data through correspondence with institutions, establishments or companies at federal, regional, zonal and grass roots levels;
- field observation survey on the various component activities in the watershed areas of the lakes;

B. Identification and evaluation of the collected data

- impact indicators will be identified or valued for the negative and the positive impacts
- impact analysis matrix will be used for compare and contrast purpose

C. Explanation of the environment

- biological environment
- social environment
- physical environment
- chemical environment
- others will be explained.

6. Expected Output of the Research Project

The establishment of sustainable use of Lake Tana fishery to yield the greatest benefit to the present generation whilst maintaining the potential of the lake meet the needs and aspiration of the future generations in manner compatible with maintenance of the natural biodiversity of the lake and their value to its environs. The research project also generates the environmental baseline data that could serve as first hand information for future development activities on the lake system and its environs.

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Indigenous Knowledge: its significance for wetland management in Illubabor Zone

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Abstract

Rural communities in Illubabor Zone have built up a considerable body of knowledge about the dynamics of wetlands. This indigenous, or local knowledge includes variations in vegetation, soils, geomorphology and hydrology. Much of this knowledge is used by these communities to identify major changes which are taking place in wetland ecology and therefore contributes to decision making about the management of these areas. While this knowledge is not formalised or uniformly distributed, it does provide a considerable resource which must be recognised and should be used in a participatory approach to wetland management. Sharing this knowledge through farmer to farmer visits can help raise awareness amongst communities about the utility of such understanding. Indigenous knowledge must evolve in order to face the challenges of growing local and external pressures on wetlands. This requires the empowerment of IK resources within wetland communities, which can be achieved through the participation of both wetland users and external actors in a process of knowledge exchange and development.

1. Indigenous Knowledge and Indigenous Research

In recent years there has been an increasing recognition that local people themselves possess the knowledge and skills to manage their natural resources and environment in a sustainable manner (Brokensha *et al.*, 1980; Chambers, 1983; Richards, 1985; Warren, 1991; Scoones and Thompson, 1994). In addition, there has been a recognition that indigenous knowledge comes from the cultural context of the people it is concerned with and that it evolves in contact with specific environmental conditions (Haverkort and Hiemstra, 1999). Fundamentally, indigenous knowledge is based on societies' intimate knowledge of their environment. Local communities have, over generations, observed seasonal changes in their environment and they understand the environmental and social processes which take place.

With this recognition has grown a need to include indigenous knowledge in the rural development process, particularly as local communities are often regarded as possessing knowledge beyond that which could be attained through more formal, scientific means of investigation. Although local communities were initially regarded as the 'eyes and ears' of science when indigenous knowledge first appeared on the development agenda (Howes, 1980), more recent research has suggested that many members of rural communities, particularly farmers, are in fact researchers themselves. Evidence from around the world (Richards, 1985; Millar 1993; Rhoades and Bebbington, 1995; McCorkle and McClure, 1995) suggests that many experiment each year in some aspect of their farming, changing the timing of some activities or the way they use particular pieces of land. Experimentation may be a means of testing a new theory or simply an attempt to overcome a farming problem. Farmer experimentation is, however, the main means by which adaptations are made to the farming environment and ultimately the main mechanism through which indigenous natural resource management strategies remain sustainable in the face of change.

Recognition of this knowledge and these adaptive skills means that local communities should be seen as vital resources in the development process and as reservoirs of knowledge. They can provide rich, contextual information which would otherwise take decades to collect by formal methods of environmental monitoring and in addition, they possess the capacity to organise and apply this knowledge in ways which contribute to sustainable natural resource management.

2. Indigenous Knowledge of Wetlands in Illubabor

The rural communities of Illubabor have lived for generations in close contact with the wetlands which are prevalent in that area. Every day people collect water from the springs along the edges of their wetlands and so observe what is happening in those areas. In the search for dry-season grazing, some farmers have used the fringes of wetlands and, in so doing, learned what plants their cattle like and dislike. Every few years each household harvests reeds from a wetland to thatch their tukuls and as a result they have learned the value of different types of reeds. Some people have become specialists in wetland plants and possess knowledge of their medicinal properties. During the 20th century the cultivation of wetlands has also developed and through successful and unsuccessful experiments with drainage and cultivation, extensive knowledge of hydrology, soils and vegetation has been attained.

2.1 Indigenous Hydrological Knowledge

Local communities in Illubabor possess extensive knowledge of the wetland hydrological system, particularly the distribution and changes in rainfall and the wetland water table. They also understand the relationship between rainfall and the wetland water table in terms of catchment storage and runoff. In many ways, this knowledge can be regarded as the building blocks of their hydrological management practices in that methods of drainage and crop cultivation have been developed to suit the hydrological conditions in each wetland. For example, crop cultivation requires drainage so that the water table is lowered sufficiently to prevent saturation of the crop root zone whilst also providing the soil moisture conditions which promote plant growth. For example, one farmer at Dizi wetland related how:

> *"If the land is dry, the drain is made shallower. If the maize is yellow, then the depth is increased"*
>
> Farmer at Dizi wetland (1998)

As farmers seek to adjust their cropping patterns with hydrological conditions within the wetlands, experimentation with the layout, size and depth of drainage channels is evident. Although most wetlands possess a central drainage channel which rarely exceeds a depth of one metre, the design of peripheral channels tends to be variable from location to location and from year to year. The case of another farmer at Dizi wetland typifies the ways in which farmers are constantly striving to adapt their hydrological management to a changing environment:

> *"Here half of the maize is yellow and half is healthy. Before two years there was no difference between them but last year I lost the whole yield. This year I have dug a drain down the middle because I thought there was too much water in the soil but the result has been half good and half bad. I dug the drain through the middle because*

another farmer told me that the source of water for that area of the wetland was under an avocado tree on the valley side. Next year I will drain along the left side where the valley sides meet the wetland and this should solve the problem. Maybe I will also block the middle ditch which I made this year. The ideal depth of these ditches should be about knee height".

Farmer at Dizi wetland (1998)

Whilst this example illustrates how farmers make changes to their hydrological management from year to year on the basis of observed change, the seasonality of rainfall during the year also complicates hydrological management strategies. As a result, strategies must be flexible enough to adapt to often rapid changes in hydro-meteorological conditions in order to prevent crop damage or poor yields. Consequently farmers have developed a range of flexible strategies to address this climatic unpredictability, one of which involves the active management of drainage channels throughout the season. During dry periods of the year many farmers block their wetland drainage channels until the water table rises to a level which facilitates successful crop cultivation. Conversely, during wet periods drainage channels may be unblocked, deepened or cleared of vegetation which restricts the flow of water from the wetland.

2.2 Indigenous Knowledge of Wetland Soils

Farmers who use wetlands for cultivation have also developed extensive knowledge of the characteristics and dynamics of soils in their wetlands. The main distinguishing feature of wetland soils to farmers is the colour. Pristine wetland soils, which have not been used before for farming are generally black. These soils, called *biyo guracha* after the colour, indicate to farmers that they have a high content of vegetative matter from decaying plant material and, therefore, high fertility. Whilst the organic matter content of soils affects fertility, it is also seen and understood to facilitate the storage of moisture. This can be a problem in terms of drainage but also a benefit in that it ensures a supply of water for plant growth if the rains are late. In contrast, red soils *biyo dima*) are regarded as being less fertile and the colour is seen as a sign of a deterioration in soil quality. These soils, according to farmers, should be rested from cultivation. In several wetlands peat-like soils have also been identified. Farmers regard these as particularly fertile but they are also aware that there should be no burning on these areas as the soils would be destroyed.

In addition to burning, most farmers agree that cattle should be restricted from grazing on wetlands that are being used in any way for cultivation. In the words of one farmer at Supe wetland:

"Cattle are not allowed on the cultivated wetland because they cause the compaction of the soil and they disturb the ditches which are cleared in July."

Farmer at Supe wetland (1998)

In this wetland and others throughout Illubabor where cattle are not allowed access to the wetland, agriculture appears to have been sustained year after year with little evidence of degradation.

Farmers also possess extensive knowledge of the depths of soils in different parts of their wetlands and the subsequent implications for water storage and hydrological management.

Farmers associate shallow soils with the occurrence of bedrock near to the wetland surface which can hinder the flow of water and prevent the effective rooting of crops. During a discussion of his wetland, one farmer at Dizi related how:

> *"…some areas have a level surface and underneath these areas are stones. These stones block the water and cause the level of water to increase. These areas are therefore much wetter than uneven areas and the crops do not grow as well here."*
>
> Farmer at Dizi wetland (1998)

2.3 Indigenous Knowledge of Wetland Vegetation

Rural communities recognise variations in the wetland vegetation which outsiders would miss. They possess knowledge of the variation in the quality of reeds which grow in wetlands, e.g. those which can be harvested from regenerating areas, following several years of cultivation, are regarded as poorer in quality than those obtained from pristine wetlands. Whilst the latter will last for three or four years, a thatch made from reeds which are regenerating will last for only one or two years.

Research into the indigenous knowledge of wetland communities has also identified plants which have medicinal uses. In particular, the herb *balawarante* is collected and used as a treatment for skin diseases, whilst busuke is used as an enrichment in children's food. Other plants are use for treating headaches and throat infections.

Some wetland plants are used by farmers as indicators of changes in soil fertility or hydrological conditions. The plant *kemete* (*Leersia hexandra*) is associated with the degradation of wetlands. If this starts to colonise the wetland, farmers will realise that they need to actively restore the normal flooding regime in order to increase the nutrient supply to the wetland. Similarly the plant *inchinne* (*Triumfetta pilosa*) is used as an indicator of increasing fertility, hence its appearance in a wetland is often regarded by farmers as the end of a fallow period:

> *" Before one year, this area was being cultivated and then it was left fallow. The cheffe has increased, along with 'inchinne' and the moisture level. Ten years ago this area gave a good yield of sugar cane but the problem with sugar cane is that it rapidly exhausts the soil fertility. When the maize was planted here it became very weak so it was left fallow to allow the fertility to recover. This year the vegetation will be cleared and sugar cane will be planted again."*
>
> Farmer at Dizi wetland (1998)

If such plant indicators are ignored there is a risk that the wetland may degrade further until it is only suitable for rough grazing and it can no longer produce reeds or support cultivation. Indigenous knowledge of these plant indicators represents a critical way in which the local community can assess the state of their wetland and take appropriate action to ensure wetland use is sustained.

3. Relevance of Indigenous Knowledge Today

Indigenous knowledge is based upon decades and, more usually, generations of experiments. As such, it is often said to be based on the past and therefore of limited relevance to the present. Indeed there is a view amongst some experts involved in agricultural development

that it is unscientific and not appropriate to current conditions of rapid population growth and commercialisation. While some of these views have elements of truth for some types of indigenous knowledge, in the case of Illubabor's wetlands, indigenous knowledge remains of value precisely because of the way it can provide an understanding of the dynamic ecology of the wetlands and thereby help farmers. Local communities have accumulated experience and knowledge of these wetlands since they first started to use them and they continue to learn from their experiences. Hence their knowledge and the management practices which are based upon this knowledge, have developed in response to a range of different pressures and conditions. This makes indigenous wetland knowledge a valuable community resource which may hold the key to future sustainable wetland use.

4. Limits of Indigenous Knowledge

Although indigenous knowledge is often considerable, it is not always adequate to ensure the continued use of wetlands for cropping. Some wetlands have been identified which have lost the ability to support agricultural activities following several years of poor hydrological management that led to a fall in water table levels and an unpredictable hydrological regime. Similarly, some wetlands have experienced soil erosion and a decline in soil fertility after several years of cultivation. In other wetlands, intensive grazing has been carried out in a manner which has resulted in the compaction and degradation of the wetland soils. Clearly indigenous knowledge can not always be relied upon to sustain the use of these wetlands.

The reasons behind such examples of wetland degradation or unsustainable use are still not entirely clear, although recent research has suggested that the problem is one of farmers not being able to fully apply their knowledge and practices in their wetlands (Dixon, 2000). This situation may occur because wetland farmers are also operating within a range of environmental and socio-economic constraints such as labour shortages, climatic unpredictability, pest problems and the demands of their upland farming systems. At the present time there is some doubt over whether farmers can adapt their wetland farming systems to these constraints and in many respects, this may stem from several limitations in their current wetland knowledge system.

In particular, there is a lack of communication and innovation within the wetland farming system, which are important mechanisms in the adaptation and evolution of wetland knowledge. Consequently, the situation that exists in many of Illubabor's wetlands is one where farmers are not fulfilling their wetland management goals of high crop yields as a result of constraints. At the same time, however, hydrological management remains sustainable in that it has not led to permanent changes in the hydrological regime from year to year. Faced with the prospect of needing to improve food security farmers must respond to these environmental and socio-economic constraints in order to increase their farming success in a sustainable manner, and to do this they must overcome the present limits to their wetland knowledge system.

5. The Need to Develop Indigenous Knowledge

If food security is to be achieved at the present time and for the future, there is a need for wetland farmers to develop new management practices which can cope with a range of problems and be both successful and sustainable. This can be achieved in two ways:

- Farmers can receive external technical assistance on particular wetland management

practices;
- Farmers can develop their own solutions to problems.

Whilst the former may represent a solution in the short- term, it is itself an unsustainable approach. Alternatively, if farmers are given the opportunity to develop their own solutions, they also develop their indigenous wetland knowledge which can be used and applied where necessary in the future.

6. Empowering Indigenous Knowledge

Figure 1 suggests a framework for empowering indigenous wetland knowledge so that farmers' capacity to adapt their wetland management practices to environmental and socio-economic changes can be strengthened. The first stage would involve a recognition of the strengths and weaknesses of the current wetland knowledge system. Here there is a role to play for an external agent in bringing together the wetland community and facilitating an arena in which various members can assess their own knowledge. Key issues to be addressed could include the opportunities for knowledge exchange within the community and with other wetland communities or rural institutions. Indigenous knowledge research has also demonstrated that knowledge is not shared equally among rural communities. Hence there may be a need to recognise specific individuals who possess specialised knowledge and could be sources of ideas or key innovations and adaptations that have taken place and which should be disseminated to benefit the wider community.

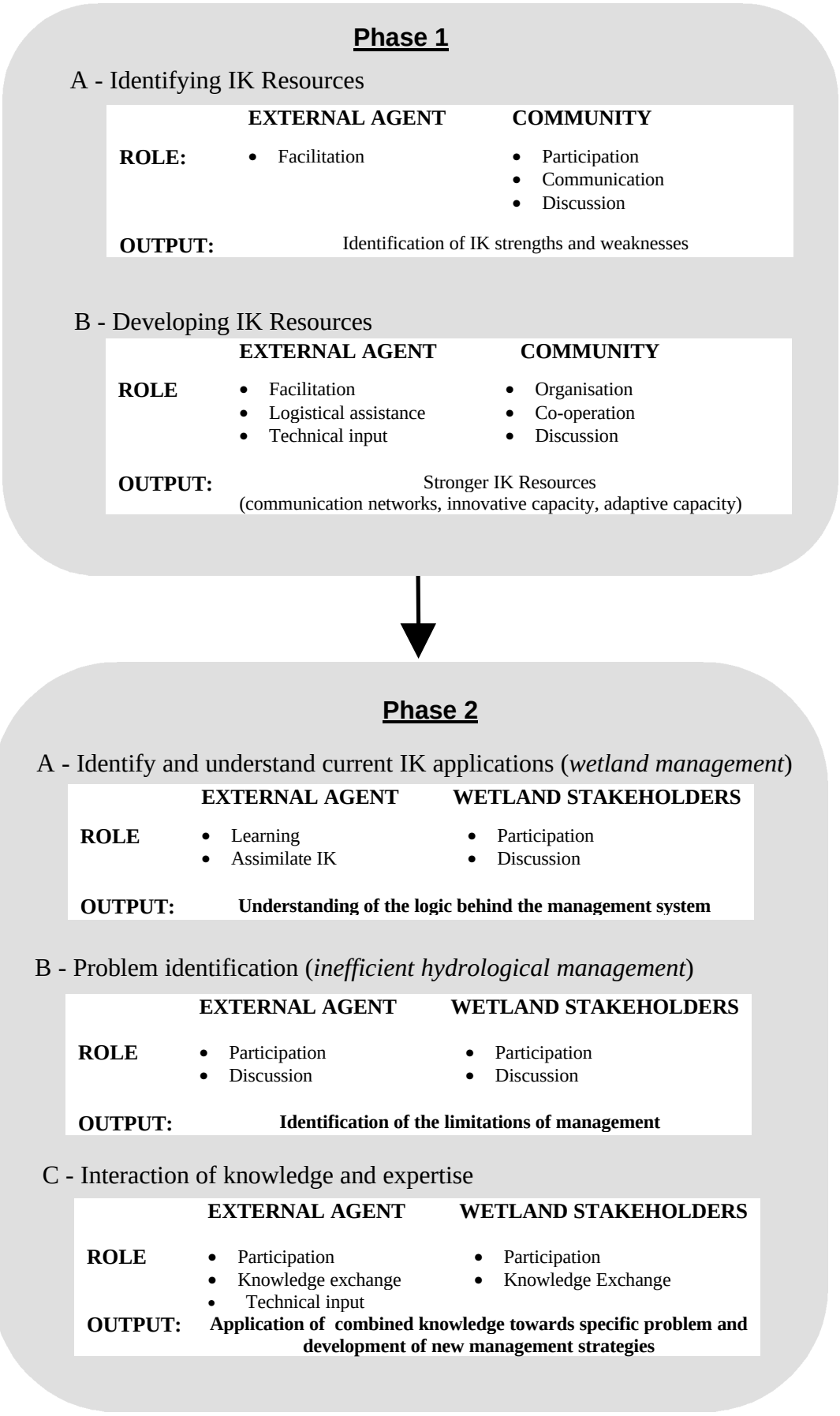
Throughout a participatory process involving external agents and wetland community members, emphasis should be placed on assisting the local community to organise their own wetland knowledge resources in a way which can promote the evolution of wetland knowledge. Recent initiatives by EWRP which brought farmers from different communities together in a series of workshops and site visits, have facilitated such an exchange of wetland knowledge, with farmers themselves claiming that they had acquired new knowledge as a result of interaction with their fellow farmers.

Once the indigenous wetland knowledge network and the adaptive capacity of farmers has been strengthened, attention can then turn towards the second stage and specific wetland management problems. The continuing process of equitable participation between the wetland stakeholders and external agents, provides an opportunity to exchange different knowledge of wetlands so that management practice experiments can be developed in the light of a wider understanding of their benefits and consequences.

7. Conclusions

It is now widely recognised that by ignoring indigenous knowledge of natural resources and their management, many mistakes have been made. Neglect of local understanding of resources has led to their degradation and to the loss of benefits for rural communities. In developing ways to use sustainably the wetlands of Illubabor and those in other parts of Ethiopia, and achieve the maximum benefits for the different groups, especially the poor, the knowledge which the rural communities already possess must be the basis for actions. That knowledge, however, needs to be shared amongst the wetland communities and further developed. The adaptive capacity of wetland users should also be strengthened so that it allows communities to cope with the increased demands which they face today.

Figure 1 - A Framework for Empowering Indigenous Wetland Knowledge.



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Wetlands, Policies and Environmental Assessment

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Abstract

Many government policies, during the last three decades or more, have impacted upon the wetlands of Ethiopia. In Illubabor zone research has shown that government policies, often supported by donors, have had both positive and, more often, negative impacts upon the sustainability of the wetlands. Government policies generally impact indirectly upon wetlands through measures which are taken for economic, social or development reasons. Local level, community-developed policies also impact upon wetlands often more directly and more positively. There is a need to ensure that all government policies, developed at whatever level, go through some process of environmental assessment which looks at their wider environmental impacts, both direct and indirect. The current work to establish such procedures at the Federal level is to be encouraged but application of similar mechanisms at regional and zonal levels must be supported. Similar procedures must be developed for use at community levels to support local policy formulation for managing wetlands in a sustainable manner.

1. Introduction

A policy is a course of action agreed by a group of people. Policies can be made at a variety of levels. Most commonly we associate policies with national government measures, but local community developed rules or by-laws are also policies. In addition, when countries sign up to international conventions or agreements they also accept the policies included in those documents. NGOs operating in an area will have their own emphases in their work which can also be seen as policies.

While there may be policies which directly address wetlands, analysis of wetland issues around the world shows that the majority of policy influences upon wetlands come from non-wetland policies, i.e. ones which do not address wetlands specifically. Such non-wetland policies can have direct impacts upon wetlands where they immediately encourage some use of wetlands, usually for a developmental purpose. In other cases, the influence can be more circuitous, with unintended impacts on wetlands occurring by chance or by neglect on the part of the policy makers.

With respect to wetlands, a framework for policy analysis can be drawn up which shows these different interactions of policy with wetlands. Figure 1 provides this with general examples.

2. Policies and Wetlands in Ethiopia

Applying this framework to policies in Ethiopia, three levels are particularly worthy of attention, the National / Regional, i.e. government level, the local / community level, and the NGO level. Once policies and their influences upon wetland are identified, then appropriate actions can be designed which, where necessary, can try to influence these policies and make them more appropriate for the sustainable use of wetlands. The long-term aim should be not

to correct policies after they have been promulgated, but to ensure that all policies go through some environmental assessment process before they are finalised and implemented.

Figure 1 - Framework for Wetland Related Policy Analysis .

	Type of Policy		
Level of Policy Formulation	**Wetland Specific**	**Non-Wetland Specific** *Direct Impact*	*Indirect Impact*
International	Ramsar		Structural adjustment
National / Regional	Environmental Policy	Food security	Wildlife protection
NGOs	Wetland use / protection	Agricultural expansion	Catchment treatment Afforestation
Community	Wetland management	Land use controls	

3. National Wetland-Specific Policies

To date there are only a few policies which specifically address wetlands in Ethiopia. The Ramsar Convention has not been signed by Ethiopia and so there is no related legislation. The Conservation Strategy of Ethiopia (CSE) and the Water Resources Policy are the only formal government policy statements to make mention of wetlands. However, they address them indirectly, focusing on them as regulators of water quality in the CSE, and for their biodiversity and assimilative capacity against pollution in the other policy. Nonetheless, awareness of the importance of wetlands has been growing in Ethiopia over the last few years and there is now a Core Group which is trying to push this issue into the national policy arena.

4. National Non-Wetland Policies with Direct Impacts on Wetlands

A number of non-wetland policies have quite immediate or direct impacts upon wetlands even though they were not designed with reference to these areas at all.

4.1 Food Security.

The drive towards food security seeks to ensure that supposedly “under-used” natural resources are developed for agricultural production. This policy has been subject to interpretation at the regional and zonal level. In some parts of the country, diversion irrigation is being encouraged. In other cases wetland drainage has been encouraged. The latter is especially attractive as it can lead to crop harvests during the food-shortage months before the main harvest. However, intensive cultivation, especially with limited knowledge about wetland management, can lead to serious degradation of wetlands.

4.2 Resettlement

The past policy of relocating people from famine-affected areas to the better watered south-west led to sudden local increases in the demand for land. Where resettlement was of the integrated type local communities faced a dilemma as to which land they allocated to the settlers. In many cases it appears that wetlands were seen as the least desirable type of land by the local communities and were given to the settlers.

4.3 Villagisation

This process of concentrating rural communities had the effect of increasing demand upon the natural resources in some localities. Demands for reeds for thatching tukuls put a heavy demand upon the wetlands near to the new villages and affected the quality of the reed beds. In addition, the need for more accessible farm and grazing land led to the drainage of wetlands in the vicinity of these new settlements.

5. National Non-Wetland Policies with Indirect Impacts on Wetlands

5.1 National Development and Commercialisation

The need to eradicate poverty in Ethiopia has seen an emphasis upon the utilisation of the country's natural resources. This has led to agricultural expansion and the clearance of forests. The resulting devegetation of the landscape has had serious impacts upon the hydrological cycle with increased variations in stream flow, and more severe down- cutting in wetlands by streams at times of peak flow. One result is that wetlands start to dry up. This allows cattle to graze them which leads to soil compaction, loss of water storage capacity and destruction of wetland vegetation.

5.2 Coffee Development

Expansion of coffee production, a national goal which has been supported by many donors, has had a number of impacts upon wetlands. Most directly the expansion of coffee land on the interfluves has displaced cereal crop cultivation from these areas into wetlands. Indirectly, coffee production, by increasing wealth, leads to greater cattle numbers whose dry season grazing needs are often met from wetlands.

5.3 Agricultural Research

Agricultural research has introduced varieties of maize which mature in a shorter period of time. Although designed primarily for upland cultivation, these varieties facilitate wetland cultivation as they can reach maturity before flooding damages the crops. Quicker maturing maize may help reduce the period for which wetlands are drained and hence the ecological damage caused by cultivation.

54 Wildlife Protection.

Wildlife protection policies when applied in the forested areas of the country seriously increase the level of crop losses to predators. This is especially high in wetlands which are usually some distance from settlements and have forest nearby. As a result wetland cultivation is discouraged by this policy.

6. NGOs and Wetland Impacting Policies

NGOs can be very important actors in Ethiopia because of the financial and human resources they possess. The policies which they develop, while often agreed with government official or communities in their area of work, may also be subject to influence from their donors. At one time wetland cultivation was seen by one NGO as a way of reducing pressure upon the forests for clearance and cultivation. Later concerns about the environmental impacts led to a complete reversal of this policy. Other NGO (and government) activities in catchment conservation have impacted upon the hydrology of an area which in turn can affect wetlands, especially by improving water storage in the catchment.

7. Community Policies and Wetlands

Rural communities make their own rules and regulations. This capacity for self management is long-standing and must be recognised. In contrast to the lack of government attention to wetlands there is considerable attention given by communities to these areas and specific policies have evolved. This is a reflection of the greater awareness of wetlands and their value by local communities. In particular it reflects the wide range of benefits which communities obtain from wetlands and their wish to sustain these.

As wetland cultivation has increased some communities, finding themselves short of reeds for thatching or pasture for grazing, have established by-laws to protect wetlands from cultivation. Communities may also co-ordinate the cutting of reeds to ensure that the resource is not degraded through intensive use. The cultivation of wetlands may also be controlled by institutions developed by the community specifically to manage these resources. As a result rules have been made about drainage practices, the protection of springs and the maintenance of reeds at the head and outlet of wetlands.

8. National Policies and Wetland Sustainability

The Conservation Strategy of Ethiopia has identified the need for strategic environmental assessment (EA). This means that all government policies should be subject to an assessment of their environmental impacts. Where necessary the policy assessed will be revised to reduce any negative impacts on the ecological security of the country.

With respect to wetlands, EA should first identify the various roles which wetlands play and their value to different stakeholders in a particular site. EA would then seek to ensure that all policies are adjusted so that the ecological functioning of wetlands is protected and the production of their various benefits is sustained.

Besides ecological considerations, there are many developmental roles which wetlands play. These include the provision of raw materials for craft activities which contribute to economic diversification and poverty alleviation, the maintenance of springs for domestic water supply and the storage of water for hydro-power and irrigation developments. In addition dry-season cultivation is also important for food security. It is these sorts of benefits from wetlands that must be protected from the negative impacts of insensitive policies. This requires appropriate EA procedures at the Federal and Regional levels. In addition specific policies concerning the protection and sustainable use of wetlands need to be developed, with local adjustments for the different ecological conditions in the country.

9. NGOs and Wetlands

While NGOs should co-ordinate their policies with the regional and zonal authorities where they are operating, given the importance of this type of organisation within the development work in Ethiopia, it is necessary that appropriate sensitisation is carried out with them. The national level organisations which co-ordinate the NGOs, such as DPPC and the NGOs own co-ordinating bodies, should help raise awareness about wetlands and their critical roles. Development activities must not end up undermining the long-term ecological security of the country.

10. Community Wetland Management

The rights of communities to manage their local matters is enshrined in the constitution. Already it is clear that some concerns about wetlands are leading communities to develop their own rules and regulations about wetlands. Some have even developed institutions which are responsible for managing these areas. These communities and their institutions can benefit from extension advice and from exchanging experience and knowledge with other groups undertaking similar activities. But above all, these institutions must develop in response to local needs and must be subject to democratic controls which ensure that the interests of all the different stakeholders concerned with wetlands and their products are considered.

11. Towards a Wetlands Sensitive Policy Environment

Raising awareness of the value of wetlands is essential for achieving an appropriate recognition of the role that these areas play at present, and can contribute to the development of the country. Maintaining the wetlands of Ethiopia and ensuring that they are used in sustainable ways must be a national policy and environmental priority. The value of wetlands needs to be recognised through economic assessments looking at the opportunity cost of the loss of wetlands. Ecological assessments are also needed to pay special attention to the role which wetland loss plays in environmental change and desertification.

Information on the value of wetlands needs to be available at all levels in the country to help inform decision making by communities, NGOs, regional governments and federal authorities. This can help inform EA at the federal and regional levels, thereby ensuring that government policies are not destructive of wetlands but support the maintenance and long term sustainable use of these areas.

However, legislation from the national level will not be sufficient to ensure the sustainable contribution of wetlands to the country's development. Rather action is needed at the local level amongst the stakeholders who are using and directly benefiting from a wetland. This action must raise awareness in the local community and assist the development of local policies which support sustainable use. For this to occur there needs to be the "policy space" for local communities to make their contributions and for this locally relevant information must be available for the communities.

Reference

1. Wood, A.P. (2000) "Policy implications for wetland management". In Proceedings of the National Workshop on Sustainable Wetland Management, 13th December, 1999, Addis Ababa, Ethiopia. EWRP, Huddersfield.

Discussion

Amhara National Regional State Government, Workshop on Wetland Awareness

January 23rd 2001

The meeting agreed that the papers presented in the workshop had helped raise awareness about the nature and value of wetlands for the Amhara Regional State and its people. At the same time a number of important gaps in knowledge and understanding of wetlands had been identified as well as problems which need investigation. In reflecting on this situation a number of activities were identified which it was agreed by the workshop participants need to be pursued in the immediate future.

1. Wetlands Awareness Creation
This is necessary at various different levels. It should start with the Regional Council so that future activities are given the fullest support from the highest level. Thereafter the zones and weredas should be covered and inter-active processes with communities begun. This sensitisation process should help government officials, communities and NGOs realise what wetlands are and recognise the value of their various contributions to the wellbeing of people. In particular the roles of wetlands in water management, food security, desertification control and economic diversification were seen as important to explore both in awareness creation and through other activities such as research.

2. Survey of Wetlands in the Region.
At the same time as the initial awareness creation activities are being undertaken, preliminary data can be collected from the existing records in government, community and NGO sources. This will provide information on the importance of wetlands as they are presently seen. Through awareness creation more detailed / appropriate data collection can be set in place. This will link to the research activities which require specific projects to undertake in-depth research over a limited period of time, rather than the continued monitoring which is undertaken through regular data collection.

Further, during the discussion the Amhara Region Agricultural Research Institute reported it had plans to undertake a preliminary investigation of wetlands in the region through interpreting or using satellite image. This was seen as a positive contribution to the future work on wetlands in the region. However, it was indicated that the funds to undertake the research work had not yet been obtained.

3. Research
Specific research programmes are needed to fill the gaps identified by this workshop and help create appropriate recommendations for the sustainable use of the wetlands of this Region. This research will include specific activities to explore the environmental dynamics of wetlands as well as investigate the local knowledge of wetlands and how property rights affect wetland management. This can also include research into local institutions for managing these areas and the way in which the conflicts between different users can be resolved.

4. Capacity Building and Networking
Many government staff, and also staff in some NGOs, need to receive training about wetland

issues, rather than just awareness raising. Training material should be developed for these activities and specific courses run to meet the needs identified in the awareness raising activities. The research findings will feed into the creation of extension materials which can be used to build up capacity at the community level. A network of staff and community members skilled in sustainable wetland management should be produced by this work. It is very important that this network functions smoothly so that all the different types of groups which get involved in wetland work are able to share knowledge and experience. Sharing of information among local institutions within the region will help avoid redundant activities within the region.

5. Policy Review and Development
Awareness raising, training, data collection and research will raise questions about the way in which government policies impact upon wetlands. A process to address the need for environmental assessment of policies should be developed once sufficient material is available.

6. Institutional Responsibility Allocation
An inter-agency Task Force to support the development of wetlands awareness and the other activities above should be established in the Region. An inter-agency organisation is necessary due to the multi-sectoral nature of wetlands and the issues which need to be addressed in them. In time it is recommended that the shortly to be established Environmental Protection and Land Administration Authority would be the best organisation to take responsibility for the wetlands issue. They will need to identify and involve stakeholders, and also identify the appropriate responsible organisations. These must include in a major way the farmers and communities using wetlands. The Amhara National Regional State Agricultural Research Institute (ARARI) should take the lead in the research activities proposed above and the Bureau of Agriculture's Land Use Section should lead in the wetlands awareness work. Until the Land Administration Authority is established the Bureau of Agriculture and ARARI were given a common responsibility to set up the Task Force and follow up the activities.

7. Donor Identification and Sources of Technical Expertise
It was agreed that a number of donors might well be interested in supporting wetland work in the Amhara Regional State. These include: Sida, USAID, UNDP-GEF, Cida, and the Science and Technology Commission.

In addition it was pointed out that some agencies have particular expertise in wetland issues such as IUCN, Wetlands International, Wetlands Action and the Ethio-Wetlands and Natural Resources Association.

8. Project Development
It was agreed that a proposal for research and awareness activities should be develop for inclusion in the next five-year development programme for this region.

Appendix 1: Workshop Programme

Amhara Regional State Bureau of Agriculture

Wetland Awareness Creation and Activity Identification Workshop

Tuesday, January 23/01, Bahar Dar, Venue, Bureau of Agriculture

WETLANDS ARE A SOURCE OF LIFE			
Time	Activities	Presenter	Chairperson
8:30 – 9:00	Registration		
9:00 – 9:10	Welcome speech	Ato Koyachew Mulluye, Head, Regulatory Department BoA	
9:10 – 9:30	Opening speech	Dr Belay Demissie, Head, Agricultural Bureau	Dr Gete Zeleke
9:30 – 10:00	Wetlands: role and importance in Ethiopia	Dr Adrian P. Wood, HU/Wetland Action	Dr Gete Zeleke
10:00 – 10:30	Wetland distribution in Amhara Region, their importance and current threats	Ato Abye Kindie A/Landuse Team Leader	Dr Gete Zeleke
10:30 – 11:00	Coffee Break, video and posters show	All participants	
11:00 – 11:30	Lessons and challenges of researching in Amhara Region: Advice for future research work	Dr Gete Zeleke Acting General Manager, ARARI	Dr Lemlem
11:30 – 12:00	Researching on wetlands in South-western Ethiopia: The experience of EWRP	Ato Afework Hailu, EWNRA	Dr Lemlem
12:00 – 12:30	The ecological and socio-economic contributions of Lake Tana to the surrounding community: Current and potential threats	Dr Ralph Lee, Bahar Dar University	Dr Lemlem
12:30 – 2:00	Lunch Break		
2:00 – 2:30	Fishery resources in Lake Tana: Current status and future possibilities as well as challenges for sustainable use	Ato Abebe Ameha, Dr Martin de Graaf and Ato Miheret Endalew, Department of Fishery	Ato Tamene Teriuneh
2:30 – 3:00	The contribution of Indigenous Knowledge for sustainable wetland management: An example from Illubabor	Dr Alan B. Dixon, Huddersfield University	Ato Tamene Teriuneh
3:00 – 3:30	Wetlands, policies and environmental assessment: Some Ethiopian experience	Dr Adrian P. Wood HU/Wetland Action	Ato Tamene Teriuneh
3:30 – 4:00	Coffee Break, video and posters show		
4:00 – 5:45	Discussion	All participants	Dr Belay Demissie
	Closing remarks	Dr Belay Demissie	

Co-hosted by Amhara BoA, Wetland Action (including Huddersfield University (HU), UK) and Ethio Wetlands and Natural Resources Association (EWNRA)

Appendix 2: Workshop Participants

Name	Organisation and Work Title	Address
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Abye Kindie	BoA	Tel. 200913
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USAID, EPA, AAU and Sida were invited to the workshop but could not attend.