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Adugna Babu
Bule Hora University. Faculty of
Agriculture. Department of
Natural Resources Management;
P.O. Box No: 144. Bule Hora.
Ethiopia.

Dr. Bogale Teferi
Dilla University. Faculty of
Social Science and Humanities.
Department of Geography and
Environmental Studies. P.O.
Box No: 419. Dilla. Ethiopia.

Correspondence:
Adugna Babu
Bule Hora University. Faculty of
Agriculture. Department of
Natural Resources Management;
P.O. Box No: 144. Bule Hora.
Ethiopia.

Assessment of Human Induced Threats to Warameda Wetland Dale Woreda Southern Ethiopia

Adugna Babu, Bogale Teferi

Abstract

Wetlands are unique landscapes which provide services constantly during dry and wet season of the year. Therefore their year round benefits make them the most valuable and attractive component of the environment. The Southern Nations, Nationalities and Peoples Region of Ethiopia (SNNPR) have a variety of wetlands within different ecological zones. These include lakes swamps marshes flood plains etc. In Dale Woreda there are many wetlands varying in size. Warameda wetland is among the famous and the largest wetland in the Woreda. The aim of this research was therefore to assess the anthropogenic factors contributing to the degradation of the wetland and to recommend alternative management strategies in order to promote its benefits for the local communities and environmental functioning. In order to undertake this research; household survey focus group discussion field observation and key informants were interviewed to collect primary data. In addition to describe the trend of change of the wetland Landsat TM 1986. Landsat ETM 2000 and SPOT 2006 were used. Accordingly; the wetland has been highly encroached by human settlement eucalyptus plantation pollution sand extraction overexploitation of resources from the wetland and agricultural activities. Based on the result of the study the authors recommended the concerned bodies to alleviate the impact of human pressure from this wetland.

Keywords: Wetlands, Degradation, Management.

Introduction

Wetlands are defined as: “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 meters” [29].

Wetlands are becoming increasingly recognized as important natural resources because of their ability to fulfill a range of environmental functions and produce a number of products that are socially and economically beneficial to local communities (Dugan, 1990 and Silvius *et al.* 2000 cited in [7]. Wetlands provide a large array of ecosystem services – defined as benefits people derive from nature. They are also used for farming fishing and livestock grazing [6, 20]. They supply families with basic needs such as water construction material and fuel.

Wetlands also have considerable aesthetic cultural educational and spiritual values and provide sustainable opportunities for recreation and tourism [16, 17].

The abundance of water in the wetlands also supports the growth of dense sedge vegetation known locally as *cheffe* (*Cyprus latifolius*) which in addition to providing limited agricultural usage fodder for cattle is traditionally harvested by local communities for use as a roofing and craft material. It is also used throughout the year in a range of ceremonies and celebrations and, as such it is a marketable commodity [7].

In addition to these local values the system of interconnected wetlands play a crucial role by filtering pollutants and regulating water flows (influencing ground water recharge flood impacts and water availability during the dry season) [10, 34, 15].

Managing wetland ecosystems are paramount essential to safeguard wetlands for local communities and environmental functioning and regulation [18, 35, 17]. Hence management of wetlands is the promotion of these services. But, they are at risk mostly due to population pressure throughout the world [26]. Wetlands have progressively been lost and degraded due to human activities for thousands of years. They are now recognized as being lost at a rate that is greater than for any other type of ecosystem [2, 24].

The Ramsar Convention on Wetlands was developed as a means to call international attention to the rate at which wetland habitats were disappearing in part due to a lack of understanding of their important functions and values. Human impacts on water sources for agricultural.

Industrial and settlement are some of the reasons why wetland ecosystems are degraded at an alarming rate throughout the world [29]. The Convention on Wetlands is an intergovernmental treaty adopted on 2 February 1971 in the Iranian city of Ramsar on the southern shore of the Caspian Sea. Thus though nowadays the name of the Convention is usually written “Convention on Wetlands (Ramsar, Iran, 1971)” it has come to be known popularly as the “*Ramsar Convention*”. Its mission is “the conservation and wise use of all wetlands through local regional and national actions and international cooperation as a contribution towards achieving sustainable development throughout the world”.

The primary indirect drivers of wetland degradation have been population growth and increasing economic development. Whereas the primary direct drivers of wetland degradation and loss include infrastructure development agricultural expansion (cultivation and overgrazing) water withdrawal pollution over harvesting and overexploitation and the introduction of invasive alien species [10, 13, 26, 27].

In Ethiopia different stakeholders local community’s governmental and non-governmental organizations use wetlands in uncoordinated manner and this approach is affecting the vigor of wetlands and speeding up their degradation. As a result wise use of wetlands has not yet been given proper attention and priority [31]. Lack of a comprehensive wetlands policy and implementing law coupled with the absence of an institution duly empowered to issue and implement wetland laws and coordinate management activities is the underlying cause for the deterioration of wetlands of Ethiopia.

Absence of policy and proper institutional arrangements are the key factors limiting affirmative actions against the degradation of Ethiopian wetlands [21]. Ethiopia is not yet a party to the Ramsar Convention and has not yet developed wetland policies.

Wetland management in Ethiopia also suffers from capacity limitations such as lack of skilled manpower finance and technology. As a result there is shortage of wetland specialists. There is also awareness problem from grassroots up to decision maker level [31].

The southern Nations, Nationalities and Peoples Regions of Ethiopia (SNNPR) have also a variety of wetlands within different administration zones. These include lakes swamps marshes flood plains etc. The prominent wetlands of southern region are Gidabo river sub-basin wetlands. The major wetlands of Gidabo River include Dukale wetland and the warameda wetland along with other small wetlands.

In Dale woreda there are many pockets of wetlands in different agro ecological zones. Most of them are small except Warameda which is large and covers three peasant associations. Most part of this wetland is flooded during the summer season and dried up in dry season. However there are Permanent River crossing the wetland and springs that supply water. From field observation it was noticed that the wetland is highly encroached by settlement plantation of higher water demand tree species (eucalyptus plantation) and diversion of water for agriculture. The other problem of the wetland is overgrazing during dry season where large stock of animals graze without proper management. Therefore in view of the above statements the researcher is motivated to focus his study on assessment of the anthropogenic causes of the wetland degradation and suggest possible remedial action to sustain the wetland.

MATERIALS AND METHODS

Background of the Study Area

The study was conducted in Dale Woreda which is located between 6°27'00"- 6°51'00" N latitude and 38°00'00" - 38°37'00"E longitude in Sidama Zone. Southern Region of Ethiopia. This Woreda is one of the 21 Woredas in the Zone covering a total area of 1.494.63 km².

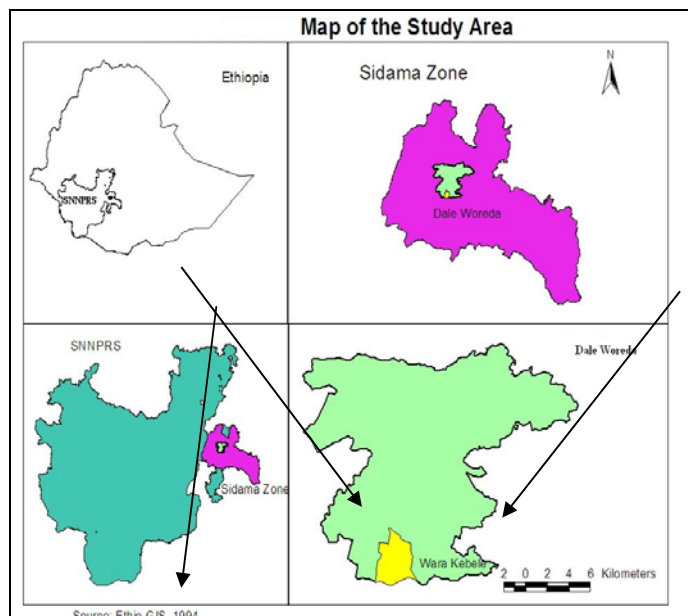


Fig 1: Location map of the study area

The study area is bordered by Boricha and Shebedino woredas in the north and North West; Loka Abaya woreda in the west; Aleta wondo wereda in the south and Wonosho Wereda in the east and north east. The capital, Yirgalem town is placed southeast of the main road from Addis Ababa to Dilla town at a distance of 317 km from Addis Ababa and some 42 km southeast of Awassa.

Drainage system

There are two main watersheds. Gidabo and Bilate and four sub watersheds in Dale woreda. Gidabo is the largest watershed in and around the study area covering a total area of 216.817.74 ha and comprising of four sub-watersheds [19].

Bilate watershed is the second largest watershed of the study area. It covers a total area of 116.010.27 ha. Dama, Raro, Wamole and Woyima are sub-watersheds of Gidabo watershed each covering area of 8.170.56 ha, 5.580.72 ha, 16.938.72 ha and 4.678.11 ha respectively.

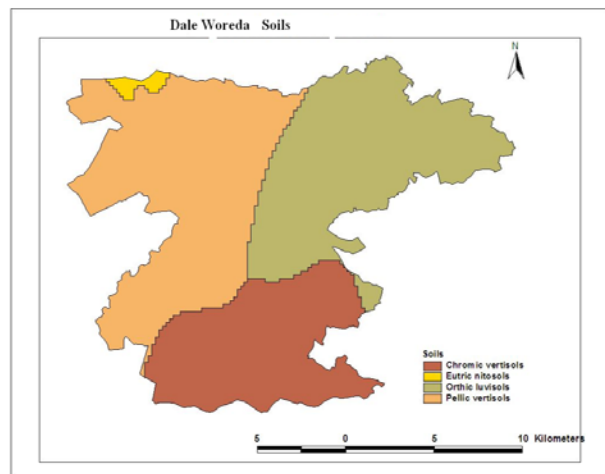
Climate

The altitude of the study area ranges from 1800-2000m. This shows the relief feature of the woreda is mostly flat. The study area is largely found in the agro climatic zone which is dominated by Dry Woina-Dega in the Western part and moist Woina –Dega in the Eastern part.

Soils

Dale woreda is covered by different soil types such as chromic vertisols which covers the southern part of the woreda ; Eutric nitosols in the northern part of the woreda; orthic luvisols in the eastern and North-east ; and pellic vertisols in the northern west and south-west part. The dominant soil type of the

woreda is pellic vertisols followed by orthic luvisols.



Source: Ethio-GIS database. 1994

Fig 2: Soil map of Dale Woreda

Methodology

Data collection methods

The primary data for this study was gathered through Questionnaire, Field Observation, Focus Group discussion and Key informant interview to assess the management status and major threats to propose effective management strategies to enhance human benefits and environmental sustainability. Questionnaires were prepared in both open ended and close ended forms and were distributed among 60 households living in and around the wetland.

In addition to primary data collection secondary data were collected from different sources. The data that were collected from secondary sources include related documents studies and other useful written materials needed for the study from internet sources study reports survey reports and other significant published papers. The purposes of using these secondary data were to identify the triggers of wetland degradation due to socio- economic factors.

Furthermore, Satellite images of the study area were used to analyse the nature of the wetlands and changes over time. Landsat TM 1986, Landsat ETM 2000 and SPOT 2006 were obtained from the Ethiopian Mapping Authority. Landsat TM 1986 and Landsat ETM 2000 have 30 meter resolution while SPOT 2006 has 5m resolution.

Using GPS satellite images and topographical maps the wetland types were identified in the field. Based on the results of the field observation the wetland types were labeled and reproduced on a map using ERDAS 8.6 software. Accordingly two types of wetlands were identified; precipitation dominated wetland and surface water and ground water dominated wetlands. Furthermore the land use classes of the wetland were also identified.

Furthermore the qualitative data that were gathered through interviews focus group discussion key informant interview and field observation were analyzed using content analysis by describing and interpreting the situation deeply and contextually so that the real human driving factors of the wetland were explained.

Results and Discussion

According to the informants of some local elders the warameda wetland was unenchrached until the first half of

the nineteen century. But as a result of rapid population growth rate the wetland has been highly disturbed by human interference after the second half of the nineteen century particularly starting from the year 1960s till present. The change in the wetland system was analyzed using satellite images of 1986, 2000 and 2006. Accordingly five types of land use systems were identified (Table 1`).

Table 1: Description of Land use classes found in Warameda wetland

Land use	Description
Cultivated land	Cultivated land comprising field plots used for production of both annual and perennial crops
Plantations	Areas covered with planted trees mainly <i>Eucalyptus</i> and <i>Juniperus procera</i> at different heights. <i>Cordia africana</i> , <i>Aningeria altissima</i> , <i>Millettia ferruginea</i> , <i>Podocarpus falcatus</i> , <i>Ficus sur</i> , <i>Ficus Vasta</i> <i>Syzygium guineense</i> , <i>Teclea nobilis</i> , <i>Croton macrostachyus</i>
Precipitation Dominated wetland	Areas that are waterlogged in the rainy season and relatively dry during the dry season. Used as supplementary grassland; a good source of grass for the dry season.
Settlement	Areas composed of small villages and/or scattered hamlets
Surface and ground water dominated wetland	Areas that are waterlogged, marshy and swampy in all seasons

The wetland has been classified under two categories namely surface and ground water dominated wetland which is wet round year and precipitation dominated which holds water and becomes wetland during rainy season of the year. The wetland is in the hand of both communities and individual holder. The part of the wetland which is under the communities is used as communal grazing land. The conversion and diversion of the wetland for the agricultural purposes was started in 1985 by one farmer for the first time. Later on through gradual process the local communities have made it their sedentary life as it can be stressed based on the results of the study.

Human induced threats to the wetland

Despite their contributions wetlands are being degraded at an alarming rate in most parts of Ethiopia. Draining and converting of wetlands in to crop or vegetable fields is common in several parts of Ethiopia especially in areas where there is shortage of cultivable land and rapid population growth [31]. This aspect of wetland conversion has attractive temporary economic return for few people who are involved in the business especially in dry seasons. However where such activities lead to complete drainage of wetlands for profit making they become the most devastating type of threat to wetlands. It abolishes many other short- and long- term economic environmental and socio-cultural benefits of wetlands to a wide range of beneficiaries.

In the same way the wetland of the study area is exposed to several degrading factors due to high population growth and scarcity of farm land and lack of proper management. The major human factors leading to the degradation of the wetland include conversion to agriculture expansion of human settlement overgrazing deforestation eucalyptus plantation pollution from coffee washing plants sand and stone extraction and overexploitation of wetland resources. These problems are emanated from the mismanagement situation.

Conversion to Agricultural Land

Draining of wetlands for agricultural purpose is a century old practice in some parts of the country mainly in Southwest Ethiopia. Long term draining interferes with the ecological recovery of the wetland system and will fasten its drying up [25]. Cultivation activities in wetlands are done during the two seasons of dry and wet seasons by all the farmers mostly in developing countries.

However cultivation in and around wetlands is mostly done in an intensive way with water from the wetlands providing the needed water for the crops [14, 33].

In similar way according to the informants of some local elders the wetland was unencroached until the first half of the nineteenth century but as a result of rapid population growth rate the wetland has been highly disturbed for the purpose of agriculture after the first half of the nineteenth century particularly since 1960s. Drainage land clearing and conversion to cropland qualify as a permanent loss of wetland [4,18,32]. As it has been found out during the investigation proper management of the wetland is completely absent by the local communities. In the study wetland. The diversion of the wetland canal at dry season to produce cereal crops like. Maize (*zea mays*). And haricot bean (*phaseolus vulgaris*) are common practices by the farmers of the study area. The cultivation of the wetland twice a year is prominent.

Mostly. The practicing of multiple cropping. For instance maize with cabbage. Sugarcane. Haricot bean and others are common. Coffee seedling and plantation. Plantation of chat (*Catha adulis*). Sugar beet and sugarcane and some fruits like. Lime. Orange. And avocado by complete diversion of the wetland are commonly practiced. Despite these benefits. The wetland is under anthropogenic pressure and is being changed to agriculture entirely. These problems are emanated from unwise uses and rapid rate of population growth. Hence. The conversion of the wetland to agriculture coupled with the draining of the water. Particularly; at dry season are the major threats to the wetland. Resulting from drainage of the wetland. Especially during dry season. The water level of the wetland is reduced at unprecedented rate.

Moreover. The clearing of vegetations. Which contribute much in the recovery of the wetland such as sedges and other wetland grasses and trees which cover and play key roles in protecting loss of water from the wetland through evaporation are cleared for the purpose of agriculture. Therefore. The wetland has been highly exposed to evaporation which leads to complete removal of water.

Overgrazing

Grazing by domestic stock. Predominantly cattle; lead to some consequences which include soil compaction. And vegetation loss [3]. Furthermore. Combining of cultivation and grazing observed in parts of southwest Ethiopia is a severe problem resulting in soil compaction. Reduction of moisture storage and finally drying of the wetlands [22].

In the study area. Overgrazing is one of the crucial problems of the degradation of the wetland among others. The informants said that the communal part of the wetland is under the hands of four kebeles for grazing purpose. The four kebeles that use the wetland to graze their cattle include Wara. Megara. And Wicho and Dongora kebeles. The communities of these take their cattle daily for grazing without any means of proper utilization and management. At present. Over grazing that is caused by these local tribes contribute much too current wetland loss in the study area. As it has been

discovered during field observation. Over 5000 livestock graze on the wetland. Since a large portion of the wetland is communally grazed. Every individual take their cattle there where and when necessary because it is open access and freely used. As a result of continuous overgrazing some of the important wetland vegetation such as *Cyprus latifolius* as well as some wetland grasses trees and shrubs which are essential to characterize the wetland are completely consumed and destroyed by the livestock. Likewise the soil compaction is another major problem as a result of overgrazing in the wetland which reduces the soil porosity that allows the movement of water air and other nutrients in the soil. When continuous cultivation is followed by grazing wetlands become easily degraded and lose their natural characteristics. Stocks trample the soil and compact it their grazing also destroys the natural vegetation and they erode water channels leading to gully and increased water outflow. These often result in the complete degradation of wetlands by reducing the water table and by changing the original vegetation [1, 8]. This overgrazing has some impacts on many wild animals' habitats by degrading their residential shade of wetland grasses and other small plants (shrubs). Beyond overgrazing it was observed that some farmers tie their cattle using rope which enhances severe wetland degradation. Soil compaction and deterioration of some important wetland vegetations.

Moreover. As some informants said the cattle owners of the communities living in and around the wetland compete each other for wetlands having good and long grasses. These competitions among the farmers of the study area fostered the purlieus communities to engage directly in severe shrinkage of the wetland. Using it in unsustainable manner to graze their cattle. Some local communities experienced scarcity of fodder. It is emphasized that as a result of continuous over grazing round the year beyond the carrying capacity of the wetland imposed by managerial problems due to lack of rules and regulation on restriction of livestock number and when to take livestock for grazing purpose. The majority (80%) of communities living in and around it faces shortage of grazing. These people have large number of livestock approximately ranging from 12-25 per household and predominantly experience scarcity of fodder for their cattle because some of them haven't privately small plots of wetland area around their backyard for grazing purpose due to shortage of farm land. But. Others do have small plots of wetland privately around their home area that does not match with their livestock number. Regarding the management of the wetland. There is no action taken by the local communities to mitigate the problems. One of the major challenges of the wetland is its communal ownership.



Fig 3: Degradation of the wetland through overgrazing

Settlement

As it was observed during investigation. The wetland has been highly encroached by settlement. As the informants of the study area said during focus group discussion. Before 1960. The wetland was unoccupied by human settlement as well as other human activities except grazing. At that time the overall use of the wetland was only for grazing. Starting from 1960 onwards. The wetland has been encroached by settlement.

However. The population settled in and around it in 1960. Was too small and the wetland was not much altered. But. The wetland has been affected due to human settlement beginning from 1960s until the present. Despite occupied by settlement in the years 1960s. 1970s. and 1980s. The wetland has been moderately affected. But. The wetland has begun to be severely encroached by human settlement after 1990. Because of rapid population growth and land fragmentation. Settlement is the major threats to the wetland since it encourages other factors contributing to the degradation of the wetland. That means. Due to the expansion of settlement. The wetland has been converted to agriculture. Eucalyptus plantation. Clearance of forest for expansion and construction of home and other human pressures on the wetland are imposed by settlement. Therefore. The wetland is highly shrunk. Some essential vegetations of the wetland have been cleared. The water table of the wetland has severely been reduced.



Fig 4: The encroachment of the wetland by settlement

Deforestation

Wetlands are under continual threat from deforestation due to population growth and the associated expansion of farming. Increasing demand for fuel and construction of wood [23]. Deforestation increases runoff and this will alter the hydrological regime and little infiltration might occur which might not be able to sustain spring flow year round [12]. Deforestation of swamp forests for wood and other craft products significantly alters wetlands [28].

In the study area. Trees are mostly cleared for the purpose of producing of timbers predominantly for commercial purposes followed by the construction of houses and other home material (table. chair. desk etc). Fencing and fuel wood.

According to the information gathered through the focus group discussion. Due to high population growth rate. Some indigenous trees such as *cordia Africana*. *podocarpus falcatus*. *Aningeria altissima*. *Ficus sur*. *prunus africanus* and *millettia ferruginea* are at risk in the study area. In particular. *cordia africana*. *podocarpus falcatus*. *Nigeria altissima*. And *millettia ferruginea* are disappearing at an alarming rate from the study area.

Eucalyptus plantation

Eucalyptus plantation is also one of the crucial human induced factors contributing to the shrinkage of the wetland. It has been observed that the in and around of the wetland has been dominated by eucalyptus plantation. Due to the expansion of eucalyptus plantation. The water table of the wetland has been severely declined. The soil moisture has also been absorbed. As a result. Large portion of the wetland is dried and completely lost. As it was seen during field observation. Many surrounding springs that feed the wetland are dried due to the expansion of these trees.

As informants said. Some communities of the study area prefer to plant eucalyptus trees for many reasons including commercial purposes. Construction. Fencing. And fuel wood. According to the household respondents. The communities living in and around the wetland have planned to expand this tree now a day. Some of the reasons why the local people prefer to plant this tree is that the area is accessible for transportation and market area.

Selling it to the local market area. They generate high income from it to facilitate and fulfilling their livelihood. The information gained from the communities confirmed that the income they generate from it is by far amount greater than the production of some crops. For this reason. In the study area. The plantation of eucalyptus. Particularly. For commercial and constructional purposes is the major threat to the wetland.



Fig 5: The encroachment of the wetland through eucalyptus plantation

The other factor that enforces the local communities to encourage plantation of eucalyptus is disagreement among the farmers of the study area on land use. That means. Not all farmers have interest to plant this tree. Traditionally. Local people know as the eucalyptus has unprecedented impact on the environment by absorbing soil moisture and large volume of water from the wetland spring. The respondents said that if one farmer plants eucalyptus on his own farm land. The farm land of the other farmer located near to it remains unproductive. Due to this problem. Knowingly majority of the farmers have shifted their plan to plant eucalyptus.

In addition. Another factor that encourages the local communities to plant this tree is that the plantation of eucalyptus does not require more management except during its plantation and fencing then after. This is again one of the reasons for the expansion of eucalyptus in and around the wetland. In the study area there is an assumption that when crops are cultivated they need management and guarding starting from their plowing to harvesting periods. It also consumes huge amount of labour force. Hence. Labor preference is one of the reasons for the expansion of eucalyptus trees.

Sand and stone extraction

The other human induced threat to the wetland is the extraction of sand and stone from its lower side required for different construction projects.

The rural communities of the wetland together extract and sell it to brokers for the purpose of income. The majority of these people who take part in the extraction are some rural poor people who mostly live by their daily labor force.



Fig 6: The impact of sand and stone extraction on the wetland

Pollution

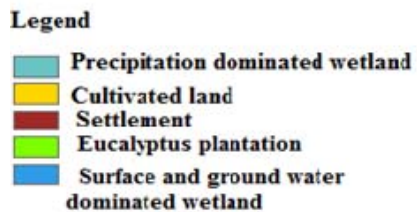
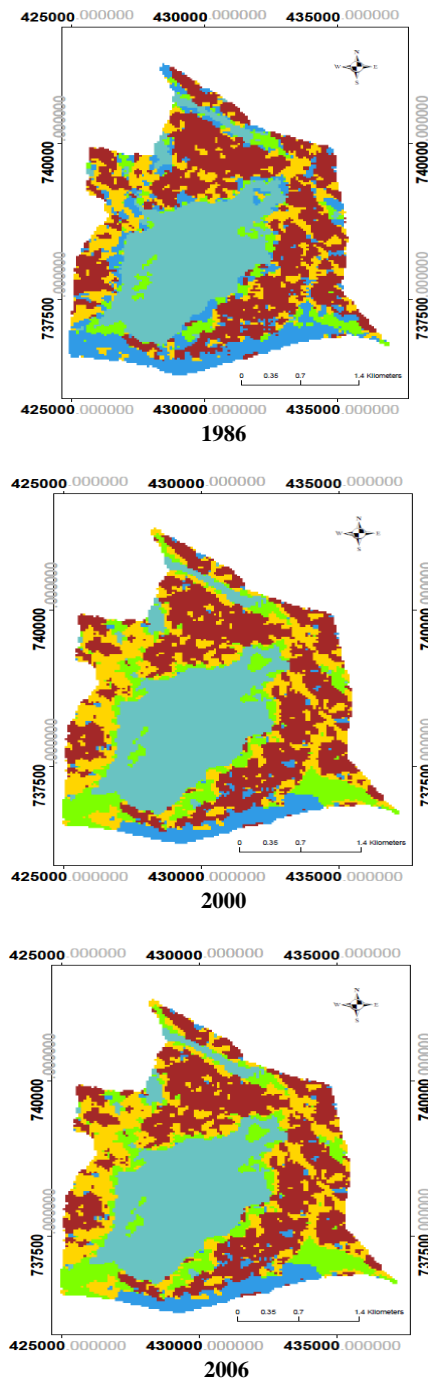
Pollution occurs through inappropriate human actions. Poor management of chemicals and poor waste disposal mechanism is the major pollution threats to sustainable wetland resources [11]. Likewise, Pollution is also one of the crucial challenges to the wetland. It affects the overall ecological functioning of the environment. The wetland is highly affected by the pollutants generated from coffee washing plant. This coffee washing plant is found between Dale woreda and Aleta wondo woreda. The waste product of coffee that is generated from this plant directly enters the Dale woreda. Particularly the spring of the wetland. As some elders said during focus group discussion. Before the establishment of the plant. The spring of the wetland was full of some fish species. They used to eat these fish species. Catching through different techniques mostly during summer reason of the year when the water volume highly increases. However. After the establishment of the plant; fish species were disappeared. Moreover. The pollution of this coffee washing plant has also triggered the expansion of many animal diseases.

Overexploitation of wetland resources

There are the poorest households that mostly rely on the wetland since there is no other source to sustain their livelihoods.

Over harvesting of the wetland resources by the communities is also a major threat to this ecosystem. Since the majority part of the wetland is under communal hand. Everyone has access to overexploit the natural products from it including, cheffe. Reeds and other wetland grasses mostly for earning purposes. That means it is open for all communities; no one care for it. This is also. The other human challenges to the wetland.

In addition to all the above human induced threats to the wetland. Hunting was common starting from previous government until the Derg Regime. As the communities said. The wetland was full of many wild animals. Due to this illegal action. Some wild animals. For instance. Monkey and bushbuck (*Antelope cervicapra*) were extncted. Again. Some bird species like pigeon (edible bird) was also disappeared. But. Post Derg. According to the government principle. Hunting was avoided.



Source: Landsat TM 1986. LandsatETM+2000 and SPOT 2006

Fig 7: 1986. 2000 and 2006 maps of Warameda wetland

Table 2 indicates the land use and amount of cover changes of the wetland. Accordingly. In 1986 cultivated land. Settlement. And eucalyptus plantation occupied 16%. 32% and 7.6% of

the wetland respectively. Moreover, In the same year, 27.4% and 17% of the wetland was precipitation and surface and ground water dominated respectively. While in 2006, 20.5%, 33.7% and 14% of the wetland was converted to cultivated land, Settlement and eucalyptus trees respectively. As a result,

Precipitation dominated and surface and ground water dominated wetlands were declined to 26.8% and 5% respectively. Eucalyptus plantation is one of the land use types of the wetland which is increased at rapid rate. It increased from 7.6% in 1986 to 14% in 2006.

Table 2: Trends of Warameda wetland in 1986, 2000 and 2006

Land use and land cover types	Area in hectare			Area in percentage			Land cover and land use change in ha (1986-2006)
	1986	2000	2006	1986	2000	2006	
Precipitation dominated wetland	310	319	307	27.4	28	26.8	-3
Cultivated land	188	221	235	16	19.3	20.5	47
Settlement	368	381	387	32	33	33.7	19
Eucalyptus plantation	87	153	161	7.6	13.3	14	74
Surface and ground water dominated wetland	194	73	57	17	6.4	5	-137
Total	1147	1147	1147	100	100	100	

Conclusion and Recommendation

Conclusion

The Warameda wetland is under unprecedented human pressure resulting from rapid population growth rate. The factors contributing to the loss of the wetland are associated with misuses and managerial problems. The crucial challenge to the wetland management is mostly its ownership under communal grazing land. Since the large portion of the wetland is under communal, It encourages the local population to use when necessary in unsustainable manner. The major anthropogenic factors contributing to the degradation of the wetland include conversion to agriculture, Overgrazing, Eucalyptus plantation, Settlement, And deforestation, Sand and stone extraction, Pollution and over exploitation of the wetland resources. The wetland is also highly influenced due to the country's weak policies regarding the management of the wetlands.

Recommendations

Based on the results of this study, The following suggestions are provided to promote the wetland sustainability and foster the wetland benefits for future use. The major appropriate ways of the wetland management are the following.

- The diversion of wetlands in to agricultural land is increasing year after year.
- Therefore, The complete diversion of the wetland for agriculture particularly during dry season should be avoided. That means, The diversion of the wetland for agriculture should be in sustainable manner. To this end, The DAs should aware the farmers on their part and the kebele administration should take necessary action to protect the wetland.
- Population growth rate is a serious problem in the study area with a growth rate of 2.9%.The rapid population growth rate should be controlled through many mechanisms such as, The use of contraceptive method, Unless population growth is halted, It is difficult to conserve every natural resource mostly in developing countries, Awareness creation and provision of contraceptives by the health centers is essential.
- The wetland is supporting large number of livestock without proper management. Thus, In this regard, The kebele administration and DAs need to create awareness among the farmers, That means, The communities living in and around the wetland should limit the number of their livestock to what the wetland can support.
- Limitation of the day and duration of the wetland for

grazing is essential. Especially, Daily grazing should be restricted mostly at summer season during the recovery season of the wetland as a result of flooding. It is important to ensure that nothing interferes with flooding of the wetland during wet season because flooding plays a crucial role for the recovery of the wetland.

- The local communities should formulate rules and regulations among themselves to limit and judge the number of livestock that can be grazed in the wetland from each and every house to control overgrazing beyond the carrying capacities of the wetland.
- There is a need to control clearing of trees in and around the wetland by the kebele administration and DAs. This is because, Trees or forests are important to enhance the down movement of rain fall in to the ground and add the amount of water which the wetland can store. Again, The presence of the wetland vegetation is also paramount in controlling erosion in and around the wetland. Therefore, Cutting of many tree species for commercial purposes particularly for timber production should be controlled.
- There is a need to protect the wetland from pollution resulting from the coffee washing plant through effective efforts of stakeholder participation.
- The occupation of the wetland by unplanned settlement should be forbidden by the kebele administration and local elders.
- The extraction of sand and stone from the wetland by the daily laborers of poor rural communities should be controlled by the kebele administration and DAs. There is a need to create other job opportunities for these people by the government.
- There is a growing demand for the growing of eucalyptus for domestic use as well as sale to get additional income. The plantation of eucalyptus by farmers in and around the wetland which consumes large volume of water and absorb soil moisture should be strictly halted by DAs and the woreda natural resource management experts. In this manner, It is possible to inform and consult the local communities about the impact of eucalyptus on the wetland.
- The local communities should get training services by the woreda natural resource experts regarding the role of the wetland in poverty reduction, Ecological functioning for environmental well –being and the triggers of wetland loss to create awareness and realize the wetland management for future use.

- There should be Clear policies and its implementation concerning management of wetlands from the government side. The policies of different sectors which apply need to be harmonized towards conservation of the wetland.
- There is a need to increase sharing of wetland management experience amongst the NGO community and between NGOs. CBO. LAs. And GOs.

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