

# Fishery Resources, Conservation Challenges and Management Strategies in Ethiopia

Tamenut Desalegn<sup>1\*</sup>, Takele Shitaw<sup>2</sup>

<sup>1</sup>Department of Wildlife Conservation and Ecotourism Management, Mekdela Amba University, Tulawlia, Ethiopia;

<sup>2</sup>Department of Fisheries, Wetlands and Wildlife Management, Ethiopian Biodiversity Research Institute, Addis Ababa, Ethiopia

## ABSTRACT

The purpose of this review article is to explore the fishery resources, potentials, conservation challenges, and management strategies of Ethiopian water bodies. Ethiopia is one of the landlocked countries in the horn of Africa characterized with a wide range of ecological, geographical, edaphic, and climatic conditions that account for a wide diversity of its biological resources both in terms of flora and fauna. It has a high diversity of Ichthyologic Fauna, accounts for over 200 fish species. In average, the production potential yield of Ethiopia is accounted for 94,500 tons per annum in different water bodies. However, the actual production is 38,370, still far below the estimated potential yield. The main factors contributed to low production of fish including illegal fishing activities, lack of awareness, overfishing, wetland degradation, deforestation, invasive species, lack of infrastructure, and technologies. Capacity building towards aquatic policies, legislation and regulation, community empowerment, pollution control, invasive alien species control, threatened species conservation, integrated watershed management plan, illegal fishing, area and seasonal closure, and public awareness creation is needed to save the water bodies and to increase fishery production.

**Keywords:** Challenge; Conservation; Ethiopia; Diversity; Fish resource; Management

## INTRODUCTION

Ethiopia is a land-locked country in the horn of Africa gifted with numerous aquatic resources, including over 20 natural lakes, 12 large river basins, over 75 wetlands, and 15 reservoirs [1]. Micro and macro dam construction and river impoundment have created innumerable large and small water bodies stocked with fish for fisheries [2]. Both inland capture fisheries and aquaculture activities are concentrated around the many lakes and rivers in the Rift Valley, as well as around the Blue Nile, which supplies water to the country's largest water body. The inland water bodies cover approximately 7,400 km<sup>2</sup> and there are 7,185 km of rivers [2,3]. Hence, the country is rich in fish diversity and abundance. Ethiopia also characterized by a wide range of ecological, edaphic, and climatic conditions that account for a wide diversity of its biological resources both in terms of flora and fauna [4]. The major geographic features are massive highlands, mountain, and plateaux divided by the Great Rift Valley and surrounded by

lowlands along the periphery [5]. Those natural factors described above powerfully influenced Ethiopia's extraordinary range of terrestrial and aquatic ecosystems and contributed to be endowed with a high diversity and rate of endemism [6]. Fisheries resource in Ethiopia, in spite of its significant contribution to poverty alleviation and food security, is an unexploited natural resource [7]. In average, Ethiopia can produce over 94,500 tons of fish per annum in different water bodies [8]. However, the country inadequate in food security and the economic growth is minimum, due to lack of technologies capable of resolving the problems of fisheries production. In worldwide, there are different threats of lakes include; accelerated Eutrophication, invasive species, toxic contamination, overfishing, water diversion, acidification, and climate change [9]. However, major conservation challenges of fish and fisheries in water bodies of Ethiopia are suffered from anthropogenic activities, illegal fishing activities like using narrow mesh size nets and poisonous plant seeds that cause toxic to the fish, lack of awareness of the community in fisheries management,

**Correspondence to:** Tamenut Desalegn, Department of Wildlife Conservation and Ecotourism Management, Mekdela Amba University, Tulawlia, Ethiopia; E-mail: tamenutdesalegn15@gmail.com

**Received date:** February 09, 2021; **Accepted date:** February 23, 2021; **Published date:** March 2, 2021

**Citation:** Desalegn T, Shitaw T (2021) Fishery Resources, Conservation Challenges and Management Strategies in Ethiopia. Fish Aquac J. 12:273.

**Copyright:** © 2021 Desalegn T, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

no fish stock assessment has been done so far, limited institutional, technical and financial capacity and low research and development capacities, overfishing, wetland degradation, Dam construction for hydropower and irrigation, deforestation, urbanization and industrialization [2,10]. Therefore, the aim of this paper is to review fishery resources in different water bodies, conservation challenges and fishery management strategies in Ethiopia.

### FISH DIVERSITY IN ETHIOPIA

Ethiopia is endowed with several water bodies (lakes, rivers, streams, reservoirs, and substantial wetlands), consequently it contains a high diversity of Ichthyologic Fauna [8,11,12]. Froese and pauly list 175 species occurring in Ethiopia included six subspecies and ten introduced species [13]. This checklist was based on incomplete literature data which is not fully updated and sometimes erroneous which makes it questionable and dubious. However, the new modified checklist stated that there are 200 fish species in freshwater bodies of Ethiopia, which belong to 75 genera, 31 families, and 12 orders (Table 1) [14].

Table 1: List of native fish species in Ethiopia [14].

Order	Family	Genera	Species	
Ceratodontiformes	Protopteridae	1	1	
Polypteriformes	Polypteridae	1	3	
Anguilliformes	Anguillidae	1	1	
Osteoglossiformes	Osteoglossidae	1	1	
	Notopteridae	1	1	
	Gymnarchidae	1	1	
	Mormyridae	8	16	
	Gonorynchiformes	Kneriidae	1	1
Characiformes	Alestiidae	4	11	
	Distichodontidae	5	9	
	Citharinidae	1	2	
Cypriniformes	Cyprinidae	9	69	
	Balitoridae	1	1	
Siluriformes	Auchenoglanididae	1	2	
	Bagrida	1	3	
	Claroteidae	2	3	
	Schilbeidae	4	6	
	Amphiliidae	3	3	
	Clariidae	2	5	
	Malapteruridae	1	2	
	Mochokidae	5	18	
	Cyprinodontiformes	Cyprinodontidae	1	2
		Poeciliidae	1	7
Nothobranchiidae		2	6	
Perciformes	Channidae	1	1	
	Latidae	1	3	
	Anabantidae	2	3	
	Cichlidae	6	11	

	Gobiidae	1	1
Tetraodontiformes	Tetraodontidae	1	1
Total		70	194

From the total number of fish species, 194 are native, 40 are endemic, and 6 are exotic species. Three of the introduced species (*ctenopharyngodon*, *idella*, *Esox lucius*, and *Hypophthalmichthys molitrix*) apparently did not establish as self-sustaining populations in natural waters after their introduction and are not included in the checklist (Table 2). The distribution of fish species and overall diversity within the drainage systems is extremely uneven [8]. For example, in the Rift Valley, fish diversity is highest in its southern part, lowest in the central part, and intermediate in the northern part. The highest fish species of two diversities in Ethiopia has been recorded from Baro basin, followed by Abay, Wabishebele, and Omo-Gibe basins. However, endemism seems to be highest in Abay and Awashbasins. This is attributed, in the former case, to the endemic species flock of *Labeo barbus* in Lake Tana (Table 3) [15].

Table 2: List of endemic fishes in Ethiopia [14].

Family	Species
Distichodontidae	<i>Nannaethiops bleheri</i>
Cyprinidae	<i>Barbus spec. "Bale"</i>
	<i>Barbus arambourgi</i>
	<i>Barbus spec. "Abaya"</i>
	<i>Barbus tanapelagi</i>
	<i>Labeobarbus acutirostris</i>
	<i>Labeobarbus brevicephalus</i>
	<i>Labeobarbus crassibarbis</i>
	<i>Labeobarbus dainellii</i>
	<i>Labeobarbus gorgorensis</i>
	<i>Labeobarbus gorguari</i>
	<i>Labeobarbus longissimus</i>
	<i>Labeobarbus macrophthalmus</i>
	<i>Labeobarbus megastoma</i>
	<i>Labeobarbus nedgia</i>
	<i>Labeobarbus osseensis</i>
	<i>Labeobarbus platydorsus</i>
	<i>Labeobarbus surkis</i>
	<i>Labeobarbus truttiformis</i>
	<i>Labeobarbus tsanensis</i>
<i>Labeobarbus ethiopicus</i>	
<i>Labeobarbus spec 'Genale'</i>	
<i>Labeobarbus microterolepis</i>	
	<i>Labeo boulengeri</i>
	<i>Garra aethiopica</i>
	<i>Garra duobarbis</i>
	<i>Garra geba</i>
	<i>Garra igenestii</i>
	<i>Garra makiensis</i>
	<i>Garra regresses</i>

	<i>Garra tana</i>
	<i>Garra chebera</i>
	<i>Narichorinus beso</i>
	<i>Varicorhinus jubae</i>
Balitoriidæ	<i>Afronemacheilus abyssinicus</i>
Amphiliidæ	<i>Amphilius lampei</i>
	<i>Phractura spec. "Alvero and Bonga"</i>
Mochokidæ	<i>Chiloglanis modjensis</i>
Cyprinodontidæ	<i>Lebias stiansney</i>
Cichlidæ	<i>Danakilia franchettii</i>

Table 3: List of exotic species in Ethiopia [14].

Family	Species	Status
Salmonidæ	<i>Salmo trutta</i>	Established
	<i>Oncorhynchus mykiss</i>	Established
Cyprinidæ	<i>Cyprinus carpio</i>	Established
	<i>Carassius auratus</i>	Established
	<i>Ctenopharyngodon idella</i>	
	<i>Hypophthalmichthys molitrix</i>	
Cichlidæ	<i>Tilapia zilli</i>	Established
	<i>Tilapia rendallii</i>	Not certain
Esocidæ	<i>Esox lucius</i>	
Pocilidæ	<i>Gambusia holbrooki</i>	Established

### FISHERY POTENTIALS IN ETHIOPIAN WATER BODIES

Fish has historically played an important role in food security

in many countries and contributes to do so globally [7]. It provides 15% to 20% of animal proteins [16]. In Ethiopia, fish comes exclusively from inland water bodies including lakes, rivers, streams, reservoirs, and substantial wetlands that are of great socio-economic, ecological, and scientific importance [11]. Most of the information in much of the literature on the fish production potential of the country is not consistent, it contradicts each other. The majority of the estimates did not include the potential of small water bodies and in some cases even the rivers were not considered. However, Small water bodies are important for a number of reasons and could be a potential source of protein [8]. The overall potential yield of fish in Ethiopia water bodies is estimated as 94,500 tons per year (Table 4) on average. In an average, 73,100 tons per year (3.3%) for lentic (lakes, reservoirs, and small water bodies) and about 21,400 tons per year (11.9%) for the lotic ecosystems (riverine fishery). Lotic ecosystem is higher produced about 83% than previous estimates due to the larger number of water bodies considered, including the newly constructed reservoirs for irrigation development and hydropower generation [8].

Even though the overall potential yield of fish in Ethiopia is high, the actual fishery production is far from the estimated [17]. The actual exploitation of fish production is 38,370 ton/year [18]. The current fish production is still far below the estimated potential yield [7]. This is might due to several factors. Lack of technologies capable of resolving the problems of fisheries production [8], habitat degradation, and destruction are the main causes of fish stock depletion of freshwater fishes and this why fish population differs per water body, even from habitat to habitat (Figure 1) [19].

Table 4: Summary of fish production potential estimates of different water bodies in Ethiopia [8].

Water bodies type	Area (km <sup>2</sup> )	Length (km)	Fish potential yield (ton/year)	Mean (tone/year)
Major lakes	7,740		37,346-41,177	39,262
Major reservoirs and dams	1,447		7,698-8,059	7,879
Small water bodies	4,450		25,678-26,314	25,996
Rivers		8,065	18,855-23,954	21,405
Total	13,637	8,065	89,577-99,504	94,541

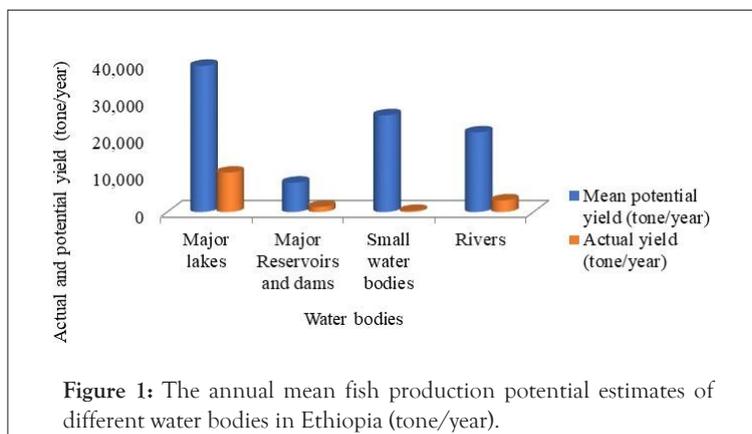


Figure 1: The annual mean fish production potential estimates of different water bodies in Ethiopia (tone/year).

## CHALLENGES TO FISH PRODUCTION

There are many rivers and lake available in Ethiopia which used for fish production, but there is still a problem regarding fish production and productivity to increase the profit of private and GDP of the country [7]. The overall potential yield of fish in Ethiopia water bodies is estimated as 94,500 tons per year on average [8]. However, the currently annual production is 38,370 ton/year [18]. This is low level of fish production may be attributed to the traditional fishing methods and equipment being utilized by the fishers. Similarly, Assefa, et al. lack of modern fishing tools and illegal fishing gears are also the challenges of fisheries of South Wollo Lakes of Ethiopia [20]. In addition to this, inefficient fishing gear, lack of motorized boat service, poor transportation access, lack of value adding facilities, lack of fish handling facilities (like refrigerator), poor postharvest handling and gear theft are the main constraints to fish production in different regions of Ethiopia [21,22]. In general, the Ethiopian fishery is under several constraints due to different challenges [7,23]. The major conservation challenges of fish and fisheries in water bodies of Ethiopia are suffered from anthropogenic activities, illegal fishing activities like using narrow mesh size nets and poisonous plant seeds that cause toxic to the fish, lack of awareness of the community in fisheries management, no fish stock assessment has been done so, limited institutional, technical and financial capacity and low research and development capacities, overfishing, wetland degradation, Dam construction, deforestation and expansion of agriculture, and Urbanization and industrialization [2,9,10,24]. These activities are affecting the Ethiopian fishery production directly or indirectly.

## MANAGEMENT STRATEGIES

More or less, all water bodies in Ethiopia are under a serious problem. The cause of water body's degradation and loss are multidimensional and complex, which leads to various unexpected costs to the society and environment, the problems usually receive less attention [25]. Therefore, management is needed to minimize factors and to improve the conditions of water bodies. According to FAO defined fisheries management as "integrated process of information gathering, analysis, planning, decision-making, allocation of resources, and formulation and enforcement of fishery regulations by which the fishery management authority controls the present and future fishing activities, to ensure the continued productivity of the living resources in", which implies to regulate the exploitation of the biomass to the level that the resource remains sustained [26]. In the other way, fishery management measures like prohibition of destructive gears such as poisonous and explosive gears of any type are fully in place; mesh regulation including both twine and mesh size, and dimensions of the net need to be standardized and adjusted to the needs and requirements of individual fish species; some area and seasonal closure have been implemented and reserve park area have been declared [27]. Area and seasonal closure refers to a protection of those parts of the lake where the target species

are known to breed, whereas a reserve area is permanently closed for fishing. Fishing activities not recommended during breeding seasons.

The capacity building and education programs can be contributed to lakes policies, legislation and regulation, community empowerment, pollution control, initiatives related to climate change, invasive alien species control, threatened species conservation, and adaptive management of ecosystems in response to a changing environment [25]. An integrated watershed management approach of the lake and its surroundings should be developed, rather than focusing only on the water bodies itself. For instance, developing of constructed wetland or establishment of waste treatment plant around the water bodies restores the lakes water quality. Especially riverine fishery should be taken in consideration during the construction of dam for hydropower and irrigation purpose [9].

Illegal fishing activities (like use of monofilaments, Seeds of Birbira tree (*Millettia ferruginea*) with Malathion and fencing must be totally prohibited. Public awareness creation towards illegal fishing, environmental degradation, and waste problems should be induced, as acceptance of the problem and behavioral changes by householders [9]. Additionally, the value and role of indigenous and traditional people in knowledge should not be left out when setting up awareness, advocacy, and capacity building [28]. Management strategies should comprise both biophysical and socioeconomic aspects with emphasis on issues like adoption of watershed/ecosystem approaches at policy level, integration of income generation in conservation activities, sharing of responsibilities/benefits among local stakeholders, institutional strengthening for environmentally and socioeconomically sustainable development of lakes [9].

## CONCLUSION

Ethiopia has over 200 fish species in freshwater bodies, which belong to 75 genera, 31 families, and 12 orders. From the total number of fish species, 194 are native, 40 are endemic, and 6 are exotic species. The distribution of fish species and overall diversity within the drainage systems is extremely uneven. The highest fish species of two diversities in Ethiopia has been recorded from Baro basin, followed by Abay, Wabishebele, and Omo-Gibe basins but endemism seems to be highest in Abay and Awashbasins. The actual fish production is still far below the estimated potential yield due to different constraints including illegal fishing activities, lack of awareness of the community in fisheries management, overfishing, wetland degradation, Dam construction for hydropower and irrigation, deforestation, invasive species, lack of infrastructure and technologies. The main fishery management strategies in Ethiopia including Capacity building and education programs can be contributed to lakes policies, legislation and regulation, community empowerment, pollution control, invasive alien species control, threatened species conservation, integrated watershed management plan, prohibition of destructive gears, area and seasonal closure and public awareness creation.

## RECOMMENDATIONS

Public awareness is needed towards environmental degradation, illegal fishing activities, proper utilization of aquatic resources, and fishery management. Capacity building is needed in various aspects of aquatic policy, legislation and regulation, community empowerment, pollution control, and encouraged environmental conservation. Gear restriction such as mesh size regulation, catch limits, closed season, or area is the most common regulatory measure needed to maximize fish production. Improving the educational level of households living around the water bodies and facilitating diversified income generating opportunities for the households living around the water bodies is also necessary in dealing with the condition. The Government of Ethiopia needs to prepare and implement an integrated water resources and fisheries management plan in the drainage basin of Ethiopia with full participation of all relevant stakeholders including the riparian community to sustain the water system in the basin. Improve fishery policies and strategies for enhancing private sector investments in fishery development.

## CONFLICT OF INTEREST STATEMENT

The authors declare that there are no conflicts of interest.

## FUNDING SOURCES

There is no funding source available.

## REFERENCES

- Alayu Y, Eshete D, Petra S. Business opportunities report aquaculture, in the series written for the ethiopian netherlands business event. 2015.
- Mitike JA, Zemedu L. Fishermen's willingness to pay for fisheries management: The case of lake zaway. *Ethiopia*. 2015;9(4): 16-22.
- Aragaw C. Pond fish farming in practice, challenges and opportunities in amhara region. In management of shallow water bodies for improved productivity and peoples' livelihoods in ethiopia, the proceedings of the ethiopian fisheries and aquatic sciences association (EFASA). Addis Ababa, Ethiopia. 2010;8(5): 61-68.
- ITTO. Guidelines for the conservation and sustainable use of biodiversity in tropical timber production forests. *Pol Develop*. 2009.
- Husen A, Mishra VK, Semwal K, Kumar D. In: Bharati KP, Chauhan A, Kumar P (eds) *Environmental pollution and biodiversity* (5th Edn), Discovery Publishing House Pvt Ltd. New Delhi, India. 2012.
- Tesfaye A, Menassie G, Getachew T, Asfaw T. *Ecosystems of Ethiopia: National biodiversity strategy and action plan (NBSAP)*, Addis Ababa. Ethiopia. 2003;3(1): 103.
- Kebede A, Meko T, Hussein A, Tamiru Y. Review on opportunities and constraints of fishery in Ethiopia. *Int J Poul Fish Sci*. 2017;1(1):1-8.
- Tesfaye G, Wolff M. The state of inland fisheries in ethiopia: A synopsis with updated estimates of potential yield. *Ecophysiol Hydrobiol*. 2014;14(3): 200-219.
- Tadlo A, Mebratu M. Challenges and possible mitigation of ethiopia fishery. *Int J Fish Aquat Stud*. 2017;5(1): 241-246.
- Desta H, Lemma B, Till S. Farmers' awareness and perception of lake zaway (Ethiopia) and its watershed management. *J Limnologia*. 2017;65(4): 61-75.
- Janko A. Fish production, consumption and management in Ethiopia. *Int J Econs and Mgmt*. 2014;3(1): 183.
- Askale GM, Tegegn F. Assessment of the fishery, challenges and opportunities of denbi reservoir in bench maji zone, south western part of Ethiopia. *Int J Fish Aquat Stud*. 2019;11(1): 7-12.
- Froese R, Pauly D. *Fishbase world wide web electronic publication*. 2010.
- Redeat H. *Fish of Ethiopia: Annotated checklist with pictorial identification*, Addis Ababa, Ethiopia. 2012.
- EPA. *Management plan for the conservation and sustainable utilization of abaya and chamo wetland*, Addis Ababa, Ethiopia, 2005.
- FAO. *The state of world fisheries and aquaculture, opportunities and challenges*, Rome, Italy, 2014.
- Lemma A. Fisheries production system scenario in ethiopia. *Int J Fish Aquat*. 2017;5(1): 79-84.
- Gatriay T. Review on assessment of factors affecting fish production and marketing in gambella region, Ethiopia. *Sci World J*. 2020;8(1): 124-136.
- Vijverberg A, Dejen E, Getahun A. The composition of fish communities of nine Ethiopian lakes along a north-south gradient: Threats and possible solutions. *J Anim Biol*. 2012;62: 315-335.
- Assefa T, Kelemework G. Assessment of current challenges and opportunities of fisheries of south wollo lakes, Amahara Region, Ethiopia. *Int J Fish Aquat*. 2013;8(3): 69-73.
- Abelti A, Janko A, Abdi T. Fishery production system assessment in different water bodies of guji and borana zones of oromia, Ethiopia. *Int J Fish Aquat Stud*. 2014;2(2): 238-242.
- Abegaz H, Tesfaye G, Cheffo A. Fishery development program: Riverine fishery assessment in gambella peoples' regional state. *Int J Fish Aquat*. 2010;11(1): 7-12.
- Mathewos T, Abebe G. Review on fishery management problems in Ethiopia: Natural and human induced impacts and the conservation challenges. *J Fish Sci Aquat*. 2016;24(4): 305-313.
- Agumassie T. Review in current problems of Ethiopian fishery: In case of human and natural associated impacts on water bodies. *Int J Fish Aquat Stud*. 2018;6(2): 94-99.
- Tamiru L. Threats and opportunities of central Ethiopia rift valley lakes. *Int J Environ Sci Nat Res*. 2019;22(2): 12-29.
- FAO. *Report of the expert consultation on guidelines for responsible fisheries management*, Wellington, New Zealand. 1995.
- Hussien A. *National fishery and aquaculture overview: Country report koica training program on fishery technology and policy for african countries*, Busan, South Korea. 2010;4(1): 34-40.
- Hagos G, Temesgen G, Abraham M. Wetland degradation in Ethiopia: Causes, consequences and remedies. *J Environ Earth Sci*. 2014;4(11): 40-48.