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Research Article

Assessment of Challenges and Practices in Nile Tilapia (Oreochromisniloticus) Farming in West Gojjam Zone, Ethiopia

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Abstract

The decline in wild fish catches due to overexploitation of fisheries resources underscores the urgent need for aquaculture to bridge the resulting production gap. This study examined Nile Tilapia farming practices in the West Gojjam Zone, Ethiopia, and identified key challenges faced by both aquaculture experts and fish farmers. According to experts, the top three constraints were: lack of government attention to fish farming (34.67%), limited awareness among farmers (17.33%), and low practical knowledge among both experts and farmers (14.67%). In contrast, farmers identified their primary challenges as: limited access to quality seed and mono-sex fingerlings (26.67%), low awareness (20.95%), and insufficient government support and knowledge on farm-formulated feeds (14.29%). The study found that the fish farming management system in the area is generally poor, particularly regarding feed management and harvesting practices. Farmers often practice mixed-sex stocking, resulting in uncontrolled reproduction, despite mono-sex stocking being more desirable—albeit largely inaccessible. Both experts and farmers exhibited significant knowledge and skill gaps in Nile Tilapia aquaculture. Additionally, over 50% of fish ponds were found to be unused, highlighting critical underutilization of resources. To enhance productivity, the study recommends continuous training programs, improved seed supply systems, and stronger government support.

Keywords: nile tilapia farming practices; challenges; management system

1. Introduction

In Ethiopia most of lakes are over exploited [1]. Fish have high source of proteins and great nutritional value. However, most of the captured fish were over exploited. Therefore, aquaculture is one alternative method to increase fish production [2]. It alleviates poverty and existing hunger [3]. Fish farming is still very low in Ethiopia and it is still negligible [4]. Aquaculture is an important source of food, nutrition, income and livelihoods for many people around the world [5]. The growth of aquaculture production in the last two decades has boosted the average consumption of fish and fish products at a global level [5]. Nearly half of the fish being consumed by humans worldwide are produced by aquaculture [5]. Global fish demand is projected to keep growing due to population growth, increased urbanization and rising incomes [6]. Tilapia, a group of species in the family Cichlidae, order Perciformes, is the second major species cultured in world aquaculture after carp species (El-[7]. More than 125 countries performed tilapia farming in 2017 [8]. In Africa, tilapia is by far (50.7%) the most commonly cultured fish species. Within Africa, Egypt and Nigeria are the first- and second largest producers of fish, respectively [9]. Nile tilapia (Oreochromis niloticus), one of the most important tilapia species, is widely cultured in tropical, subtropical and temperate regions of the world, with annual growth in production of about12.2% at present [7]. Most fish production today is in freshwater systems (99%), where carp, tilapia and catfish are the major fish species [10]. These three freshwater species are predicted to comprise around 60% of total aquaculture production by 2025 and have accounted for most of the increase in aquaculture production in recent decades [11]. There was no scientific study on Nile Tilapia farming practice in the area. Objective of this study was investigate Nile Tilapia farming practice and management system in west Gojjam Zone

2.Materials and methods

2. 1. Study Area

West Gojjam is one of ten Zones of the Amhara Region of northern Ethiopia. It is bordered on the South Oromia region), on the West by South Sudan, on the north by Gondar and on the east-by-East Gojjam. The capital town of West Gojjam is Finoteselam. It is located at about 180 km from Bahir Dar and 340 km from Addis Ababa.

2.2. Demographics

Based on the (12) Census conducted by the Central Statistical Agency of Ethiopia (CSA), this Zone has a total population of 2,106,596, of whom 1,058,272 are men and 1,048,324 women; with an area of 13,311.94 square kilometers. The study was conducted in West Gojjam Zone Amhara Regional state, seven districts including, Quarit, Debecha, Wombera, South Achefer, North Achefer and Mecha and 721 kebeles. The study was conducting in between (January 2021 to June 2021) Fig.1)

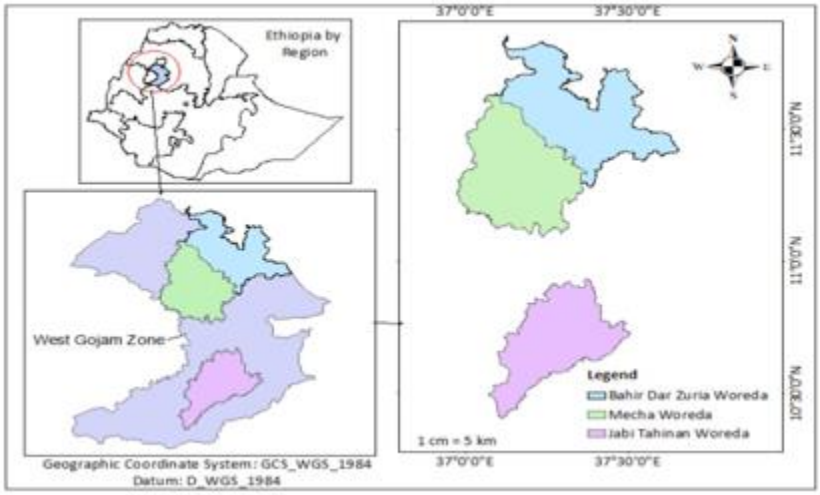

Figure 1: Map of West Gojjam Zone study area

Source (own)

2.3. Sample Size Determination and Techniques

Study districts were selected purposively based on current fish farming potential and study kebeles also select based on fish farming practices. All fish farming participates were properly register each kebele by developmental agents and selection of household's cluster based for management. purposive. Sample size fish farms and experts were 105 and respectively 75 Sample size determination for 5% precision Levels where confidence level is 95% : (13). The potential districts, kebeles and fish farmers were selected by kebele developmental agents (DA) for the success of this research data collection further analysis (Table6). There are seven districts and 21 kebeles and in one districts three kebeles were selected.

Sample districts	Sample kebeles	Fish farms per kebles	Experts in districts	Developmental Agents
Quarit	3	15	7	3
Debecha	3	15	7	4
Jabitehnan	3	15	7	4
Womberma	3	15	7	4
South ,Achefer	3	15	7	4
North Achefer	3	15	7	4
Mecha	3	15	7	3
Total	21	105	49	26

Table 4: Study districts and kebeles.

Data source (own)

2.4. Data Collected method

The data was collected using by both close ended and open-ended questionnaires and interview. Two separate questionnaires was prepared, for fish experts and fish farmers. All questions were held in Amharic and then later translated into English. Primary and secondary data were taken further analysis.

3. Data Analysis

The qualitative and quantitative methods were used to evaluate the data that had been

collected. Descriptive statistics like mean, maximum, and minimum and percentage were used.

4. Literature Review

4.1. Fish feed resources

Fish feed plays a major role in aquaculture viability and profitability because it accounts for at least 40 - 60% of the total cost of fish production [14]. The existing aquaculture practices in Ethiopia depends on feeds produced on-farm from the locally available feed ingredients of both plant and animal origin [15]. Previous research on fish feed has suggested that fish feeds can be formulated using locally available agro-industrial byproducts and alternative ingredients to increase the growth of Nile tilapia in pond aquaculture [16]. Commercial feed is un affordable and very expensive fish farmers should formulated from locally available ingredients (my observation). Ethiopia has huge aquaculture potential but it is not utilized resource as scientific way see map of aquaculture potential area. Aquaculture development is becoming visible with a better level of production since 2014 in Ethiopia. Currently, there are around 942 fish farmers (911 Males and 31 females) in different regions of the country. Most of these farmers are small scale ones working individually or established common interest groups (CIGS) organized under

cooperatives or small and micro-enterprises. Now a day fish production in fish farming showed increasing year to year 2019-2021 (Figure 1) but 2012-2018 was very low. Figure 1. showed the development of aquaculture from 2019 to 2021 radically in Ethiopian which is promising.

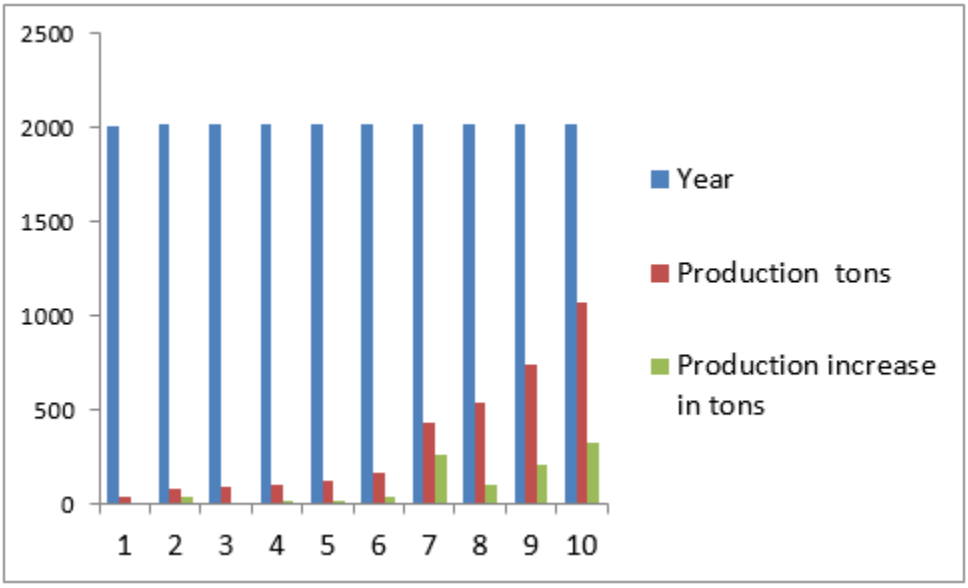

Figure 2: Fish production trend from fish farming in Ethiopia [5].

Source (FAMP, 2024)

In capture fisheries production, Aquaculture production and total domestic supply, Ethiopia is rankd six [6] which is very low. Aquaculture as share of fish production% Ethiopia is least countries from Sub-Saharan African countries (Table1). Egypt and Nigeria are the highest in capture fisheries production, Aquaculture production, total domestic supply and Aquaculture as share of fish production% (Table1)

Country	Capture Fisheries production (Tones)	Aquaculture production (Tones)	Total Domestic fish supply (tons)	Aquaculture as share of fish production (%)
Sub-Saharan Africa	7,254,848	592,540	7847388	7.8
Egypt	335,613	1370660	1706273	81.73
Nigeria	734,731	306727	1041458	30.62
Uganda	396,205	117,590	513795	22.9
Tanzania	371,228	10742	381970	2.8
Kenya	165,135	18658	183793	11.3
Ethiopia	45,519	91	45610	0.2
Rwanda	29,334	4.847	34181	14.2
Burundi	20,120	1.326	21446	6.2

Table 1: Capture and aquaculture production of fish status in Ethiopia and the rest of Easter African sub region.

Source: (17)

In fish consumption, Ethiopia is the lowest FC (kg/Person/Year which was 0.4kg and Burundi is the highest compare to East African countries (Table 2). Fish protein consumption in Ethiopia was 0.1g which is very low compare to Easter African Countries (Table2). Fish/Animal protein (%) ratio also Ethiopia is the least from east African countries but Uganda is the highest (Table2).

Countries	Popth	Total Food Fish Supply (Tones)	FC (kg/Person/Year	Fp (g/Person/ Day)	Animal protein (g/Person/Day)	Fish/Animal protein (%)	Fish/ Total protein
World	7,162,118	142,126/714	19.8	5.4	321	16.9	6.7
Africa	1,110,636	11,225,497	10.1	29	16	18.4	4.4
Burundi	10,163	20,145	20	0.6	22	28.1	1.7
Ethiopia	94,101	39,347	0.4	0.1	77	1.6	0.7
Kenya	44,354	181227	4.1	1.2	158	73	1.9
Rwanda	11,777	52,910	4.5	1.5	5.8	25.1	2.5
Tanzania	49,253	352,304	7.2	2.3	10.4	225	7.1
Uganda	37,579	469,773	12.5	3.7		30.1	7.1

Table 2: Food supply and protein intake in Ethiopia and some Easter African Countries.

*Note= Popth = Populations (Thousand) , FC=fish consumption, Fp= Fish protein

Data Source: (17)

Aquaculture as share of fish production (%) in Ethiopia is 0.2% which is less than all east African countries but the highest and the first was Egypt 87.73% and the second was Nigeria 30.62% (Table3). The water sources of Egypt is Nile Rivers which starts in Ethiopia Gish Abay town and the water tower is Gish Mountain but in aquaculture development Ethiopia is not utilized full potential that is the case why Ethiopia less than Egypt.

Country	Capture Fisheries production (Tones)	Aquaculture production (Tones)	Total Domestic (Tones)	(Aquaculture as share of fish production (%)
Sub-Saharan Africa	7,254,848	59,2540	7,847,388	7.8
Egypt	335613	1370660	1706273	87.73
Nigeria	734731	306727	1041458	30.62
Burundi	20120	1326	21446	6.2
Ethiopia	45519	91	45610	0.2
Kenya	165135	18658	183793	11.3
Rwanda	2933	4847	34181	14.2
Tanzania	371128	10742	381970	2.8
Uganda	396205	117590	513795	22.9

Table 3: Capture and aquaculture production of fish in the EA sub region in 2016.

EA (East African) and Data Source [17]

Ethiopia is rich inland water but faced with challenges that are hindering the aquaculture expansion and growth, including lack of quality seed supply, quality feed, lack of fish culture technologies, limited and ineffective extension services, poor aquaculture business support services and weak institutional framework and arrangements are few to mention The recent report indicates that fish production estimated annual production potential of 134,000 tons of fish from fish farming but actual production is 1020 which very low (0.76%) (18). Mono-sex Nile Tilapia culture system is one of the solution to increase production and productivity. Aquaculture is not well developed in Ethiopia because of the following reasons (A). Poor attention of government, experts, investors, farmer). (B). Poor knowledge and skill of experts and farmers (C). Lack of feed (quality) and even expensive. (D). Lack of male seed access and (E). Poor management (my personal observation and long time experience). The decline in wild fish catches due to overexploitation of fisheries resources made aquaculture to be mandatory to fill theses gaps. There no scientific study on status of fish farming in study area so this research was incited. Governmental Neglect in Ethiopian Aquaculture Development: Despite Ethiopia's abundant water resources and favorable climatic conditions conducive to aquaculture, the sector remains underdeveloped. This stagnation is largely attributed to insufficient governmental support and prioritization. Historically, aquaculture has not been fully integrated into the nation's food security policies and strategies, leading to its marginalization compared to other agricultural sectors [19] Several studies have highlighted the challenges stemming from this neglect. These include inadequate infrastructure, limited extension services, and a shortage of trained personnel dedicated to aquaculture development. Furthermore, the absence of a cohesive national fisheries policy and legal framework has hindered coordinated efforts to advance the sector [20] In regions like the Amhara state, integrated aquaculture initiatives have shown potential to enhance food security and livelihoods. However, these efforts are often impeded by a lack of governmental support, resulting in suboptimal pond management practices and limited adoption of aquaculture technologies (20).The cumulative effect of these challenges underscores the critical need for the Ethiopian government to re-evaluate its approach to aquaculture. By formulating and implementing comprehensive policies, investing in infrastructure, and providing targeted training and extension services, the government can unlock the sector's potential to contribute significantly to national food security and economic development. [20] Even though the general potential yield of fish in Ethiopia is high, the real fishery manufacturing is far from the predicted [21]. The real exploitation of fish manufacturing is 38,370 ton/year [22]. The current fish manufacturing is still far beneath the predicted potential yield [23]. This is because of the aquaculture improvement in Ethiopia become faced with some of challenges which consist of mainly; loss of regionally selected fish seeds, lack of reasonably priced and efficient locally to be had fish feeds, and training.[24] and shortage of government interest [25]. Timely harvesting, fish feed, seed, policy and institutional gaps were a big challenges in aquaculture [26] and [27] Experts' and Farmers' Interest towards Aquaculture. Despite the fact that there were some motivations and attempts to promote aquaculture, it is still the neglected sector compared to other agricultural activities. For instance, the budget, equipment and human resource allocated for this sector is very low. Unlike the situations observed in crop related activities, trainings and extension support related to fishery sectors is negligible. This finding is also consistent with the report of [28]. Seed production is on of the most important factures in the development of aquaculture in the world, Africa, East Africa including Ethiopia. Seed production in Ethiopia is very low compare to Egypt, Nigeria, Keneya,\. Three year production of fingerlings in Ethiopia (Figure 3.)

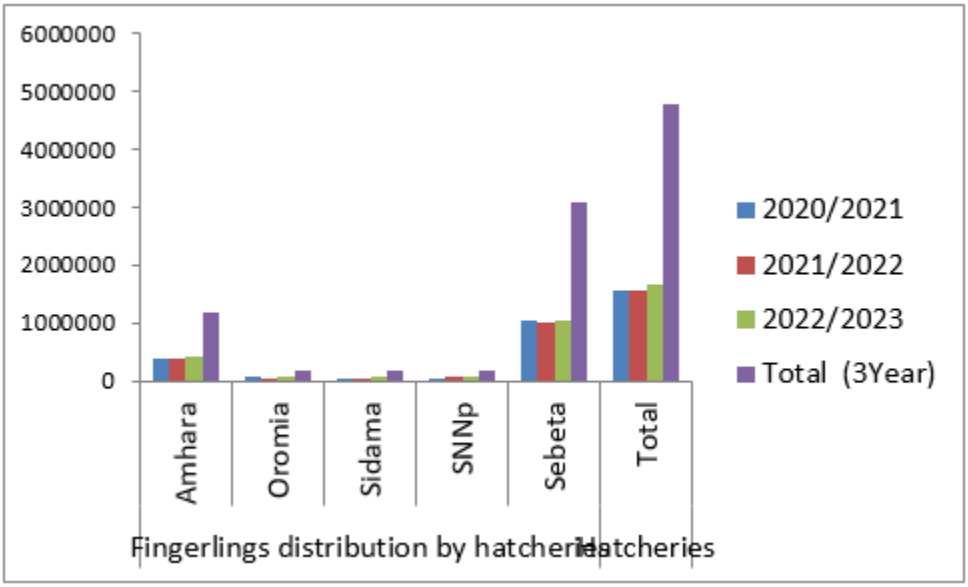

Figure 3: Source (FAMP, 2024).

Lack of Quality Seed and Mono-Sex Fingerlings in Aquaculture:

I. Importance of Quality Seed in Aquaculture: High-quality seed is fundamental to the success of aquaculture ventures. The use of genetically improved and disease-free fingerlings ensures better growth rates, feed conversion efficiency, and overall productivity. Conversely, poor-quality seed can lead to suboptimal growth, increased mortality, and economic losses. In many developing countries, including Ethiopia, the aquaculture sector suffers from a shortage of reliable hatcheries and quality seed, hindering its potential growth.

II. Advantages of Mono-Sex Fingerlings: Tilapia, particularly Nile tilapia (Oreochromisniloticus), is a prolific breeder. In mixed-sex populations, uncontrolled breeding can lead to overpopulation in ponds, resulting in stunted growth and competition for resources. Cultivating mono-sex (all-male) fingerlings is a common practice to mitigate this issue, as males typically grow faster and more uniformly than females. A study conducted at the National Fisheries and Other Aquatic Life Research Center in Sebeta, Ethiopia, demonstrated that male mono-sex tilapia exhibited significantly higher growth rates and reached market size faster than mixed-sex population

III. Challenges in Producing Quality Mono-Sex Fingerlings: Producing high-quality mono-sex fingerlings involves several challenges:

- **Technical Expertise:** Methods such as hormonal sex reversal require precise dosing and timing, necessitating skilled personnel.
- **Infrastructure:** Establishing and maintaining hatcheries with controlled environments for breeding and rearing fingerlings demand significant investment
- **Regulatory Oversight:** In many regions, there's a lack of standardized protocols and regulatory frameworks to ensure the production and distribution of quality seed.

IV The Ethiopian Context: In Ethiopia, the aquaculture sector is still in its nascent stages. The country lacks sufficient commercial hatcheries capable of producing and supplying quality mono-sex fingerlings. Most small-scale farmers rely on wild-caught fingerlings or those produced in unregulated settings, leading to inconsistent quality and performance. The absence of certified hatcheries and standardized breeding practices further exacerbates the problem.

V. Regional Comparisons and Lessons: Other African countries face similar challenges. For instance, in Kenya, the proliferation of hatcheries under government programs led to increased fingerling production. However, issues related to bloodstock management, inbreeding, and lack of technical know-how persisted, affecting seed quality.lrrd.cipav.org.co

5. Result and Discussion

Data were collected from 105 farmers, 75 Experts and 36 cooperative members by closed and open ended questionnaires including focus group discussion. The Socioeconomic profile of respondents described Table 5)

Demography of respondent	Category					
	Experts		Total	Farmers		Total
Sex	Male	Female		Male	Female	
	70	5	75	100	5	105
Age	35-56	27-48		37-52	30-42	
Educational level	Illiterate	Literate		Illiterate	Literate	
	0	79		2	19	

Table 5: Number of respondents in study area.

Data source (my own)

Nile Tilapia farming system is very poor on water exchange to maintain water quality, Growth of Nile Tilapia is stagnant, harvesting time greater than one year, (Table 6). There is no on farm formulated fish feed practice in the study area. Fish farmers fed only one ingredient powder which is not fulfill fish feed requirements and it is not suitable feeding of fish (Table 6). Generally (Table 6) showed that fish farming management system is not technically well managed.

	Name of districts						
Activities	**Quarit**	**Debecha**	**Jabitehnan**	**womberma**	**South Achfer**	**North Achefer**	**Mecha**
Maximum Pond area per m^2	100	100	100	100	100	100	100
To fertilize pond	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Stock density experience per m^2	2	2	3	2	3	4	4
Common feed type	Powder	powder	Powder	powder	Powder	powder	powder
Fed supplementary feed daily	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fed occasionally	Yes	Yes	Yes	Yes	Yes	Yes	yes
Water exchange	Yes	No		No	No	No	Yes
How many months fish reach table size	1 yr	2 yr	> 2 yr	1.5 yr	1 yr	1.5 yr	1 yr
Harvesting methods							
Partially remove water	Yes	No	No	No	Yes	Yes	Yes
Completely remove water	No	Yes	Yes	Yes	No	No	No
Timely harvest	Yes	No	No	N0	No	Yes	Yes

Table 6: Fish farming management practices system of each district.

-Data source (own) and yr (Year)

There are 72 pounds in study are but currently active ponds were 31 the reaming is empty pond which have no fish, around 50% of fish farming in the study area were under failure (Table7). In Ethiopia fish farming is not well developed duet to late adopter technology, cultural influence, there is no role model stat fish farms, and research institute.

Districts	**Number of ponds**	**active ponds**	**%**	**Empty ponds**	**%**
Quarit	3	1	1.39	2	2.78
Debecha	10	5	6.94	5	6.94
Jabitehnan	7	2	2.78	5	6.94
Womberma	8	2	2.78	6	8.33
North Achfer	9	4	5.56	5	6.94
South Achfer	15	8	11.11	7	9.72
Mecha	20	9	12.5	11	15.28
Total	**72**	**31**	**43.06**	**41**	**56.94**

Table7: Number of ponds found each district currently and active pond.

Data source (own)

From the seven major challenges of Nile Tilapia farming, experts ranked as government ignore fish farming 34..67% [1], low awareness creation of farmers 17.33% [2], experts and farmers have low practical knowledge 14.67%) [3], lack of knowledge on farm formulation fish feed 12.% [4], Lack of quality seed and mono-sex 10.67% [5], Commercial feed not affordable 6.67% [6] and (accessible & weak market access) 4 0% [7] (Table 8) . Farmers ranked lack of quality seed and mono-sex 26.67%,[1], low awareness creation of farmers 20.95% [2], government ignore fish farming 14.29% [3] and lack of knowledge on farm formulated fish feed 14.29% [3] and farmers have low practical knowledge 8.57% [5] commercial feed not affordable and accessible 8.57% [5] and weak market access 6.67% [7] (Table 8). Farmers ranked lack of quality seed and mono-sex 26.67%,[1], low awareness creation of farmers 20.95% [2], government ignore fish farming 14.29% [3] and lack of knowledge on farm formulated fish feed 14.29% [3] and farmers have low practical knowledge 8.57% [5], commercial feed not affordable and accessible 8.57% [5] and weak market access 6.6.7%.

Major challenges hidden fish farming	**Experts**			**Fish farmers**		
	Rank	**No. RS**	**%**	**Rank**	**N0. RS**	**%**
Lack of knowledge on farm formulated fish feed	4	9	12	3	15	14.29
Experts and farmers have low practical knowledge	3	11	14.67	4	9	8.57
Lack of quality seed and mono-sex	5	8	10.67	1	28	26.67
Low awareness creation of farmers	2	13	17.33	2	22	20.95
Government ignore fish farming	1	26	34.67	3	15	14.29
Weak market access	7	3	4	7	7	6.67

Commercial feed not affordable and accessible	6	5	6.67	4	9	8.57
Total respondents		75	100.		105	14.29

Table 8: Major challenges hidden Nile Tilapia farming and their ranked in study area.

* No. RS= Number of respondents

Data source (own)

Fish farming affecting by both sex stocking, Stock density, Feed, Seed, water quality, quality feed, poly culture, water depth, rotational practice. For seed reproduction purpose we can stoked male to female ration (1:2), (1:3), 1:4) and 1:5) but the production purpose only stocked males. The fish farmers stocked practice not recommended as aqua culturist (Table9 and Fig 3). There were different fish pond management system at fish farmers level Fig3 & Figure 4)

Males	Females	Sex ratio%
75	225	(0.25:0.75)
81	219	(0.27:0.73)
65	235	(0.22:0.0.78)
113	187	(0.28:0.62)
120	180	(0.4:0.6)

Table 9: Fish stocked practice as pilot took and sex ratio farmers pond.

Figure 4: Farmers fish pond.

Fishing activities in Geray Dam There was one fish cooperative in the Geray dam and the cooperative has 36 members (all are males.). Except closed season (July to September) fishing active was done every day by cooperative members. They have fishing materials (steel boat 4), read boat [16], Gillnet 100metre length [10], castanet [29] and hook and line [36]. There are four Commercial important fish species Nile Tilapia (Oreochromisniloticus), Carp (carpion), Carasis carasis After harvest the fisher men were sold their fish as whole fish and fillted. The marketing channel was Finote Selam, Markose, Injibara and Bahir Dar. There is no marking problems now a day. The major challenges in the dam ware [1]. There is no well organized fish processing house [2]. The fish offal was simply discarded but economically very important [3]. Fisher men were not give supplementary feeds for fishes for growth and reproduction 4. There no demarcation of dam and households land which was difficult to dam management. Fish cooperative members were discussed utilization of resource in the dam (Figure.5).

No	No of fisher men	Average Age	Sex	Marital status	Education status	Religion
1	36	25-48	male	married	> grade10	Orthodox

Table 10: Socioeconomic data of fish cooperative.

Figure 5: Fish cooperative members at discussion.

5.1. Discussion

Major challenges of aquaculture were, neglected by the government, lack of knowledge on farm formulated fish feed, experts and farmers have low practical knowledge, lack of quality seed and mono-sex, low awareness creation of farmers, Commercial feed not affordable and accessible major challenges that hidden aquaculture development in Ethiopia which is fully & partially aliened by before reported [19], [20], [26] and [27].Awareness creation was high challenges reported by [29] 53.33% which is greater than the present findings(20.955%). Most of the ponds, especially in South Gondar and West Gojjam were nonfunctional because of water shortage and leakage. There are also two contradictory things that shortage of fish fingerling for aquaculture and at the same time, stunted fish growth due to over population. For instance, there are a lot of huge ponds and dams, which have not been stocked with fish yet in the region due to shortage of fingerlings. On the other hand, the other ponds are suffering from stunted fish growth because of overpopulation. There were challenges (no timely harvest, nonexistence of fish feed, Skill and knowledge gap and non-existence of role model aquaculture ponds [30] which is aliened to the present findings

7.Conclusion and recommendation

71. Conclusion

Conclusion- based on experts feedback, the three top challenges of fish farming were, Government neglect fish farming [1], low awareness creation of farmers [2], experts and farmers have low practical knowledge [3] but fish farmers were ranked lack of quality seed &mono-sex [1], low awareness creation of farmers [2]. and Government neglect fish farming and lack of knowledge on farm fish feed formulation [3]. Generally fish farming management system was very poor from feeding to harvesting time in the study area. There is no farmer fed fish on farm formulated feed in the study area which is done almost extensive production system. Fish catch decline year to year in the dam so Number of boats and fish materials should be limited based on fish resources potential

7.2 Recommendation

Experts and fish farmers have knowledge and skill gaps so frequently training will be given to understand Nile Tilapia farming/ aquaculture farming system. More than 50% ponds were empty or no fish stoked so theses ponds will be stocked to increase production. Fish farming in west Gojjam Zone, both sex stocking of fingerlings for fish farmers highly difficult due to reproduction so only stock males rather than both sexes. Lake fishery management will be applied to reduced aquaculture basins. Capacity Building: Training programs for hatchery operators and farmers can enhance technical skills in bloodstock management and fingerling production.

Infrastructure Development: Investment in establishing certified hatcheries equipped with modern facilities is crucial.

Regulatory Frameworks: Developing and enforcing standards for seed quality can ensure consistency and reliability in fingerling production.

Research and Development: Collaborative efforts between research institutions and the private sector can lead to the development of improved breeding techniques and strains.

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Authors' contribution: All authors contributed to the study's conception and design. Yibeletal Aynalem was responsible for data collection, analysis, and the preparation of the original draft of the document. Alayu Yalew also supervised, reviewed and commented the document. Gashaw Tilahun critically reviewed, commented on, and edited the manuscript.

Data availability: Data will be available upon request.

Competing interest: The authors declare no competing interests.

Ethical clearance: No ethical clearance is required since the research does not involve the participation of humans and animals.

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