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Pre-extension demonstration of Nile tilapia (*Oreochromis niloticus)* fingerling multiplication method in selected site of East Showa Zone, Oromia Regional State, Ethiopia.

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ABSTRACT

This innovative way of Nile Tilapia (*Oreochromis niloticus*) fingerling multiplication method was conducted in Bora District of East Showa zone, Oromia, Ethiopia. For this purpose two ponds (6m x 8m) were prepared with the same size. One pond is hapa based and the second one without hapa based which is conventional method of fingerling production. Each hapa was stocked with 4 male and 8 female brood stocks, finally 3600 fingerling having good performance were counted with good status. Totally from the stocked four hapa a total of 14,400 fingerlings was produced within one breeding cycle. In average one female brood stock produced 450 eggs with in one time breeding section. In similar way the data was taken from the second open ponds. From this pond a total of 12,500 fingerlings harvested with in the same time and the same number of brood stock. Eventually training was given for a total of 34 participants and demonstrated the result of the activity to the participated farmers, experts and researchers. The demonstration result shown that, there was statistically significance difference between the improved and traditional fingerling multiplication methods. Therefore, hapa based method of fingerling multiplication technology was recommended for scaling up at similar agro ecological regions.

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1. INTRODUCTION

Fishing is an important source of on the current and future economy of different developed and developing countries. It is an important protein source for more than 200 million rural and urban Africans (Bene and Heck, 2005). The value of fish eating goes beyond just filling empty stomachs; fish provides nutritious and healthy food (FAO, 2015). It supplements crucial elements like iron, iodine, zinc, calcium, vitamin A, vitamin B and omega-3 fatty acids. Presently the majority of the world's fishery resources are close to the point of over exploitation. In this condition Aquaculture is the only viable alternative source of fish especially at the time when the capture fisheries are declining due to various environmental and anthropogenic factors.

Aquaculture is the most important food ingredient since the human being's history. It is an artificial method of raising fish for human consumption that also provides profitable means of livelihood for both rural and urban dwellers (FAO, 2019). Aquaculture was introduced to Sub-Saharan Africa in the 1950s with main objectives of improved nutrition in rural areas, generation of additional income, diversification of activities to reduce risk of crop failures and the creation of employment in rural areas (Hecht, 2006). However, it is not well established due to fish consumption preferences, the general level of economic development in rural areas, the policy and governance environment, and limiting social factors (FAO, 2016), together with a lack of access to available information.

Ethiopia is the most populous nation (>100 million people) in the Horn of Africa with relatively faster rate (2.6% per annum) of population growth (CSA, 2008). The country often suffers risks of food insecurity largely due to recurring drought that affects crop production. On the other hand, the country have an ample opportunity for fish production that comes exclusively from inland water bodies including lakes, rivers, streams, reservoirs and substantial wetlands that are of great socio-economic, ecological and scientific importance (Tesfaye and Wolff, 2014).

However, the majority of potential lake and other water bodies were shown signs of overexploitation, degradation of biological diversity and reduction in fish supplies and income. So, it needs to encourage alternative means of ensuring demand of fish throughout the country. Ethiopia has a high potential for developing fish culture both in terms of land, water and in its climatic regime. However, from the supply side, very little aquaculture production technique has developed and its practice has been limited to pond fish farming at farmer level with different constraints including lack of extension support and training, lack of fish fingerlings, little research and institutional capacity (Daba *et al.,* 2017). Moreover, fish fingerling is the current main problem at farm level in different fish production potential area. The objective of this study was to demonstrate fish fingerling multiplication method under farmers' conditions, to create awareness on Nile tilapia fingerling multiplication method, and to assess farmers' feedback for further technology improvement/development.

2. MATERIALS AND METHODS

2.1. Description of the study area

Bora District is one of the Districts of the East Showa Zone, which is located in Oromia Region. The District is surrounded by lume, Lake Koka, and Dodota districts in the East, Dugda in the West, Liben in the North and Zeway Dugeda and Lake Zeway in the South surrounds it. According to Central Statistical Agency (CSA, 2007) report, the total population of the District is 58,748 of which 28,261 (48%) are female. According to the unpublished Bora District Agriculture Office document the altitude of the District ranges from 1,561 to 2132 meters above sea level. Alemtena is the administrative center of the district which is located at 117Km south of Addis Ababa. Malima Bari kebele is the research site that was selected for technology implementation which is located at 8º 20'16.6" N and 38 º59 '11.3" E. Figure 1. Map of the study area.

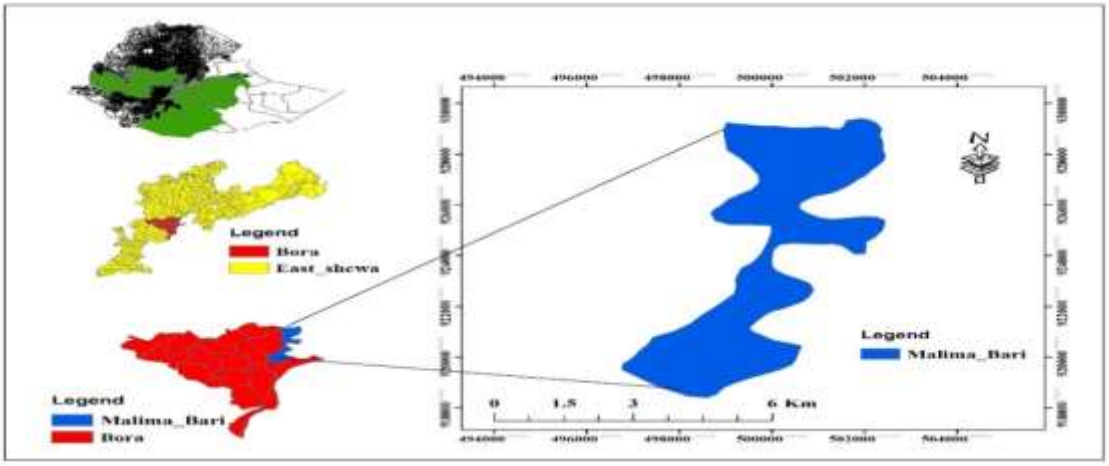

Figure 1. Description of the study area

In Malima Bari kebele, mixed farming is the dominant household activity and it is mostly confined to production of a few rain-fed crops such as fruit and vegetable crops, wheat, maize, teff, barley, chickpeas, and haricot beans. Fishing is also a common household activity in the district as well as selected kebele. Awash River was the main source for fishery activities through reservoir and pond farming.

2.2. Site and farmers selection

For the study, one appropriate site was selected based on availability of sufficient water, accessibility of site for other farmers, and potentiality for distribution of fingerlings to different farmers. Besides, farmer was selected based on their interest, working ability of farmer, willingness to allocate land, promise to manage the field and ability to cooperate the overall activities. Based on those criteria, Malima Bari kebele was selected from Bora district of East Showa zone.

2.3. Methods of technology demonstration

Before taking technology demonstration; brainstorming training was conducted on Aquaculture and fish production packages to identify the existed local knowledge of the local community. Participatory method was used for technology transfer and one FRG was used and organized for demonstration of fish fingerling multiplication method. Farmers research group (FRG) members were selected in collaboration with Districts Agricultural Office based on their interest or motivation to work, willingness to hold as member, good history of compatibility with group dynamics and willingness to share information to other farmers.

2.4. Pond preparation and fingerling multiplication process

Two rectangular shapes of earthen ponds were prepared and used for activity implementation having the area of 80m^2 and average depth of 1.20m with water inlet, outlet and overflow system on a gentle slope land near to water source. Before filling with water the ponds were treated with lime to kill potentially harmful microorganisms (like, parasites), to increase the alkaline reserve in water and mud which prevents extreme changes in pH, neutralizes the harmful action of certain substances like sulfides and acids and promote biological productivity. The first earthen pond was used for multiplying fingerlings by conventional method (local system) and the second pond was used for multiplication thorough hapa based system.

In hapa based system, four (4) 2mx1mx1m hapas were installed/suited in pond. Under each hapa three (3) male and nine (9) female and a total of 12 male and 36 female Nile Tilapia (*Oreochromis niloticus*) brood-fish of Chamo strains were stocked after conditioning. The average total length (ATL) and average total weight (ATW) of each brood stock was measured 18.25cm and 133.5g respectively. The brood-fish had been fed a locally available ration of fine wheat bran and nug cake as a dry mash twice a day. Brood fish were stocked at 3 female and 1 male ratios (3:1) on each hapa. The broods were transfer after one month and the fish fries were left to grow in their respective hapas for evaluation.

2.5. Methods of data collection and data to be collected

Material used during this experimentation were Nile Tilapia brood stock, ponds, net, fish seed, meter, water, lime, fish feed, measuring board and sensitive balance. To obtain the relevant information, the study was collecting the qualitative and quantitative data through filed observation, interview and measurement. Data such as number of farmers and experts participated in training and demonstration, essential physic-chemical parameters **(**temperature, turbidity and dissolved oxygen (DO))**,** fingerling production status on two ponds (open and hapa based) and feedback on the technology demonstrated was collected through data collection shits. Regarding on the fishing activities the secondary data were collected from published and unpublished source.

2.6. Method of data analysis

Descriptive statistics such as frequency mean and percentage were used for quantitative data and presented using tables. Qualitative data were analyzed using narrative explanation and argument. Finally the data from different sources were triangulated to generate the relevant information on the technology. Additionally, essential physical parameters like temperature, turbidity and dissolved oxygen (DO) were measured with appropriate equipments and recorded the result carefully.

3. RESULTS AND DISCUSSION

3.1. Training of farmers and other stakeholders

Technology transfer was required an improved information that help to facilitate technology demonstration. Under this activity the training was given for farmers, Development Agent, and District Experts. Multidisciplinary team including Aquaculture Research Team, Agricultural Extension Researcher Team and Office of Agriculture and Natural Resource were actively participated on awareness creation to promote the technology. The training was given in two sections from the beginning and at the final stage on sustainable utilization of the technology. Overall, a total of 34 participants were attend the training (table 2).

Table 1: Training provided for stakeholders on demonstrated technology

Participants	Male	Female	Total
Farmers	25	2	27
Das	4	-	4
SMS	2	1	3
Total	31	3	34

From the participants, the majority is male category due the nature of the activity that mainly performed by male.

Figure 2: Picture taken during field training

3.2. Physico-chemical parameters of pond water

Fishery activities are directly correlated with physical and chemical conditions of the water that play a significant role in ensuring a healthy and productive fish habitat**.** Understanding the water quality parameters for fish farming is essential for a successful and healthy yield. The main parameters include temperature, turbidity, pH level, and dissolved oxygen. Moreover, temperature, turbidity and dissolved oxygen (DO) are the essential physical parameters that directly influence the survival and growth of fish. From data collected indicated that, all parameters under optimum range that have a positive impact on fish breeding and growing system.

Table 2: Some physic-chemical parameters of experimental pond

Parameters	Hapa based	Open pond
pH	8.9	9.38
Temperature (oC)	23.97	23.71
Turbidity (NTU)	38.8	40.8
DO (mg/L)	3.99	4.14

3.3. Fingerling production status

The fingerling multiplication method was evaluated by the two earthen ponds at the study area; that is one free earthen pond and one hapa based pond. For hapa based pond four hapas were installed in the water for stocking brood stock fish. One male to every two females at both ponds were allowed. Accordingly, 4 male and 8 female were stocked on each hapa and a totally of 16 male brood stock and 32 female brood stock were used for this research activity. From one hapa or each of 4 male and 8 female brood stocks a total of 3600 fingerling were counted with good status. From these ponds a total of 14,400 fingerlings were gained within one breeding cycle.

Figure 3. Fingerling production status

On the second open earthen pond the same amount of male and female brood-stock were used and gain a total of 12500 fingerlings on the same breeding cycle and season with similar management and follow up. In this condition one female brood-stock prepare a total of 390.63 fingerlings which is below the hapa based

multiplication system with 450 fingerlings per one female brood-stock. From the evaluation result hapa based fingerling multiplication system had a significance difference from convention or open pond.

3.4. Mini field day organized and technology transfer

Technology demonstration was performed in at the study area with different stockholder. From the beginning to the end the selected farmers especially FRG members, Development Agent and Experts were participated to share their responsibility. Before undertaking demonstration, pond preparation, fish brood-stock stocking and breeding were completed. In the demonstration district Agricultural Experts. Development Agents, Farmers and Researchers were participated and evaluate the result of the activity.

Table 3: Number of participants attends technology demonstration at Bora district Malima Bari Kebele, 2024

Participants	Male	Female	Total
Farmers	35	2	35
Das	1	-	1
Experts	2	-	2
Researchers	2	-	2
Total	40	2	40

In technology demonstration about 35, 1, 2 and 2farmers, District Experts and researchers were participated on demonstration (mini-field day) respectively. Accordingly, a total of 40 participate were participated on demonstration at selected research site.

Figure 4: Picture Taken during Technology Demonstration

3.5. Economic feasibility of the technology

Technology feasibility is performed to determine the potential economic viability of the technology, and as helps to identify which technologies have the greatest likelihood of economic profitability. The following table describes the feasibility of demonstrated technology (Hapa based fingerling multiplication system) with comparing farmers practice. Results from technology feasibility analysis indicate that, 59,040 and 49,540 ETB total profit gain from improved multiplication system and farmers/local practice respectively.

Table 4: Economic feasibility of the technology

Parameters	Improved technology	Farmers practice
Fingerling gained (FG) (No fingerling/pond)	14,400	12,500

Price (p) per fingerling	5	5
Total revenue (TR)=FG*P	72,000	62,500
Brood stock purchasing cost	960	960
Feed cost	4500	4500
Labor cost	1,500	1,500
Pond depreciation cost	2,500	2,500
Total variable cost (TVC)	9,460	9,460
Cost of land	3500	3500
Total fixed costs (TFC)	3500	3500
Total cost(TC)=TVC+TFC	12,960	12,960
Profit (P) =TR-TC	59,040	49,540

3.6. Feedback assessment result

Fingerling multiplication helps to gain more seed that used for expansion of Aquaculture at potential site of Oromia Region. As feedback data assessment result confirmed that, hapa based Nile Tilapia fish fingerling multiplication method is simple and easily managed by farmer's with required management. They also approved its difference in terms of gaining more fish fingerling that has many contributions in fish production. It is cost effective and locally available materials were used for making hapa for installing in prepared ponds. For this all advantage all participants (100%) positively responded that the technology is simple to prepare and has high contribution to gain more fingerlings than conventional methods.

Additionally, stakeholders confirmed that, hapa based fingerling multiplication methods help to minimize feed dissipate and easily transfer of fry in to growing ponds or transporting. Moreover all respondents approved that, such technology help to improve farmer's income through selling fingerling for Aquaculture farming and Research Purpose. Once established, hapa based fingerling multiplication methods also performed by a single farmer in day to day management and fry transfer.

3.7. Roles and responsibilities of participants

This research activity was completed with the effort of different stakeholders. Each stakeholder had a responsibility from the beginning to the end of the activity. In this situation the research team, selected farmer and district extension personnel are the main responsible group for activity implementation.

Specifically the research team from center was performed many tasks like site and farmers selection, provide training, preparing ponds, provide fish and feed, taking continuous follow up and monitoring, data collection and analysis (table 1). On the other hand selected farmer had a responsibility to providing backward the required land for pond preparation of ponds with active participation. Extension staff also contributed through providing information to the research team, facilitation and mobilizing farmers, monitor and providing feedback.

Table 5: Role of stakeholders in technology demonstration

Actors	Roles and Responsibility
Selected farmer	Land provision, facilitation, involving in technology installation, participating on training and field day, field monitoring, evaluation technologies and providing feedback.
Research Team	Provision of training, preparing ponds, delivering all necessary materials, facilitating activities and different stakeholder participation, provision of fish seed and feed, data collection and analysis
Extension worker	Facilitating and organizing farmers, information transfer, provide technical support as local condition, continuous follow up and monitoring

4. CONCLUSIONS AND RECOMMENDATION

Fingerling multiplication method was demonstrated in Malima Bari Kebele of Bora district, East Showa zone. Training was provided for fishermen and local experts targeted with technology demonstration. Open or conventional methods used as standard check and hapa based multiplication used as new technology on the study area. The result of demonstration show that, hapa based multiplication methods have a significance deference in terms of number of fingerling gain over conventional method with the same brood stock amount and pond sizes.

Stakeholder's feedback result also confirmed as hapa based multiplication methods is simple to prepare and has high contribution gain more fingerlings that conventional methods. Therefore, those improved technology is recommend for further scaling up at different potential sites of Oromia Regional State.

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