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Review Article

Feed Resources, Formulation, Feeding Practice and Growth Performance of Nile Tilapia in Ethiopia

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Abstract:

The objective of this review was too delivered well organized fish feed resources and feeding practice in Ethiopian. Protein content of plant and animals are varied., Common animal origin fish feed sources were (Bone &blood meal 52.48% and fish meal 60.57 %, Research finding showed that highest and lowest daily growth rate were 0.88 and 0.15g respectively. maximum Tilapia daily growth rat reported (1.3 to 1.6g)), which is better than Ethiopian research works. Conclusion. There are three types of fish feeding practice in Ethiopia (commercial feed, on farm formulated feed and (ingredients as powder The most affordable and cost-effective fish feed was on farm formulated feed. Ethiopia is rich fish feed resources but not efficiently utilize the resources properly. Plants were the highest dominate in fish feeding practice compare to animal products. On farm fish feed formulation and feeding practice is not well grew due to this reason aquaculture is found infant stage compare to East Africa countries. Growth performance of Nile Tilapia was very low Ethiopia in six to ten months and body weight of Tilapia reported below (180 g). Recommendation- To boosting aquaculture in Ethiopia advanced seed multiplication center will be established and fish feed processing plants will be developed. On farm feed processing and formulation practice will be given training for fish farmers and experts

Key words: feed resources; feeding practices; feed formulation and growth performance of nile tilapia

Introduction

Global aquaculture is now the fastest growing food production in many countries and continues but more challenging in the future [1]. Aquaculture has been practiced for century's different countries and use source of cheap animal protein to numerous poorest communities [2]. However, this farming practice was introduced to so many African countries lately (sub-Saharan Africa and Ethiopia). Among the various culturing systems, semi-intensive cover 70% of finfish production in the world; majority production comes from a few aquaculture fish species such as carp, catfish and tilapia [3]. The Nile Tilapia is one of the most cultured fish contains over 60% of the total tilapia production in the world [4]. Oreochromis niloticus was advisable for semi-intensive culture system because of its ability to utilize a variety of feed originating from plants, animals or mixed feeds [5]. However, one critical challenge fish farming is feed cost [6]. Common aquaculture fish species in the world fish are carp, salmon, tilapia, and catfish. Among them tilapia is the best candidate species [7]. In Ethiopia the species offers about 60% of the total landings from major and small water bodies (8). However, recently the actual yield declined 60% to 49% [9]. The sharp decline of fish yield is related to overfishing and ecological changes of water bodies due to population pressure such as extension of agriculture and floriculture around the watershed area. Moreover, land degradation, soil erosion, and nutrient runoff have also contributed in fish biomass reduction [10]. Now a days, most water bodies of Ethiopia have been experienced with signs of overexploitation, degradation, losses biodiversity and reduction of fish resources [11]. Therefore, aquaculture is the best solution to mitigate depletion of existing fisheries. The Aim of this review was to delivered well organized fish feed resources and feeding practice in Ethiopian fish farmers, students and policy makers.

2.Fish Feed Resources

2.1. Aquatic animal protein sources

Fish meal

An important by-product for aquaculture could be from fish processing or trimmings of fish leftover such as fins, guts, bones and heads which have high protein contents which has to be processed by the food processing industry into fish meal. It is approximately estimated about 25% of all fish meal production now comes from trimmings [12]. fish wastes will be sun dried and will have a CP of 38.12%.). It reduced the feed costs/kg of diet and feed cost/kg of weight gain by 20.8% and 24.9% respectively.

Fish meal is a commercial product mostly made from bones and other leftover parts of fish after consumptions by humans [13]. It has protein value and has high effect growth of fishes because edible by the fish [14]. But it is very expensive to afford for developing countries like Ethiopia [14]. Fish feed constitutes between 50% and 70% of a commercial farmer's cost of production [15]. Fish feed constitutes between 50% and 70% of a commercial farmer's cost of production [15]. In terms of formulation and composition of feeds, several factors must be taken into account. The primary aim is usually economic, to find the least cost feed formulation that imparts a suitable nutritional quality and protein digestibility to the species in question. For this reason, it is important that raw ingredients considered in aqua feeds are researched thoroughly and that least cost options are explored. The biological efficiency of the feed is usually assessed through measuring the FCR. For instance, a near optimal 1:1, is 1kg of body mass weight gain (whole wet fish) to every 1kg of feed provided (as fed – e.g. dry pellets). Fish meal is a major source of protein in tilapia feeds but highly cost 50 -70% in semi-intensive aquacultures

Meat and bone meal

Meat and bone meal are also valuable protein and mineral source and contributes to the protein, energy and mineral component of diets [16]. It is reported that the meat /blood and bone meal protein may replace up to 50 % fish meal protein in the diet of gilthead sea bream juveniles without compromising growth and feed efficiency. [17] replaced fish meal up to 60 % with meat meal without affecting weight gain, feed efficiency or protein efficiency ratio in Japanese flounder. Blood and bone meal have several advantages, including high protein content, with well-balanced amino acids profile; good source of digestible minerals, (phosphorous and calcium) and lack of anti-nutritional factors [18]. Slaughterhouse wastes, including blood are considered as a potential protein source that can be utilized to replace fishmeal in aquaculture diet

2.2. Plant feed resources

Agro-industrial by-products

Agro-industrial by-products are rich in energy and protein contents. They have less fiber content, high digestibility and energy values compared with the other class of feeds. The major feed resources agro-industries by-products milling were (wheat bran, wheat middling, wheat short and rice bran, edible oil processing by-products (soybean cake, Niger seed cake, rapeseed cake, cottonseed cake, linseed cake, ground nut cake, sesame cake, sunflower cake, peanut cake and safflower cakes) [19].

Wheat bran: The wheat grain consists of about 82% endosperm, 15% bran, and 3% germ it is the major milling by-product used as livestock feed as well as fishes in Ethiopia. Wheat bran is quite palatable and is well known for its laxative characteristics because of its swelling and water holding capacity. This is due to its high fiber and non-starch carbohydrate content [20].

Wheat middling is a by-product of wheat milling. During milling, 70-75 % of the wheat grain becomes flour, and the remaining 25-30 % results in by-products. Wheat middling consists of fine particles of wheat bran, wheat shorts, wheat germ, wheat flour, and some of the by-product from the tail of the mill. Wheat middling cannot contain more than 9.5% crude fiber and must have minimums of 14% protein and 3% fat [21].

Maize gluten

Maize gluten is one of the important co-products of starch industry obtained from the removal of most of the starch and gum through wet milling. Incorporated corn gluten meal, corn gluten feed and corn distiller's grains with soluble in tilapia (O. niloticus), a diet with 32 % and 28 % protein. The results showed that 28% protein diet with 67% corn gluten was adequate for tilapia fry to weight gain, feed conversion ratio and protein efficiency ratio.

3. Feed Industries in Ethiopia

There are several private and union commercial feed manufacturing industries in Ethiopia which mainly produce feeds for poultry production. Currently the feed industries are operating below their capacity due mainly to low demand, high cost and low quality of feeds produced [22]. The animal feeds produced in Ethiopia are mainly composed of the ingredients corn, bone and meal, soya bean cake, Noug cake, rapeseed cake, limestone, salt, vitamin, lysine and methionine. Most ingredients are found locally as the byproducts of factories but some are imported There are a total of 81 feed enterprises found in the Ethiopian commercial feed sub-sector as shown in (Table 1). The feed industry includes feed processing plants, farmer unions, supplement manufacturers, feed processing machinery and forage seed producers. Most of these enterprises are found in Addis Ababa [23].

Region	Feed processing plants	Farmers Union	Supplement importers / Manufactures	Feed processing Machineries	Total enterprises
Addis Ababa	10	1	10	4	26
Amhara	4	7	0	0	11
Oromia	12	6	4	1	23
SNNPR	4	6	1	0	11
Tigray	2	8	0	0	10
Total	**32**	**28**	**15**	**5**	**81**

Sources:(23) .

Table 1: Animal and fish feed processing plants

Fish feed requirements

Protein requirements of fish increase from larva fries to adult and amount of carbohydrate greater than crude lipid and crude fiber. Fish feed formulation depends on type of fish, age, size, stage. body weight sees (Table2). Common fish feed proximate composition in Ethiopia reported by scholars the highest protein was reported bone and meat and the lowest was raw soybean (Table 3). The highest and the lowest crude fat was recorded row soybean and bone& meat meal (Table 3). The ash value was higher in bone & meat meal but lower raw soybean (Table 3). The locally available ingredients proximate composition were reported by different scholars (Table 7 and Table 18).

Life stage	Weight (g)	% Requirement
First feeding Larva	0.02-1	45-50
Fry	1-10	35-40
Fingerlings	10-25	30-35
Juveniles	25-200	30-32
Adults	>200	28-30
Brood stock	-	40-45

Source (24)

Table 1: **.**Protein requirements of Tilapia at different life stage

Feed ingredients	DM (%)	CF (%)	CP (%)	Ash (%)	Calcium
Bone & Meat meal	95.78	3.54	46.87	32.64	7.8
Soybean Meal	91.89	6.45	43.37	6.22	0.201
Raw Soybean	92.36	15.73	33.40	5.112.72	-

Sources**:** (25)

Table 3: Chemical composition of feed ingredients applied in Ethiopia and reported by (25**)**

Ingredients	Dm	CP	CF	Ash
Linseed cake	90.88	31	13.63	8.27
Niger seed cake	92.8	32.42	20.11	9..7
Soybean cake	93.8	39.38	6.48	5.4
Fish waste meal	95.	61.09	0	22.04
Wheat grain	87.5	9.6	5.79	13.6
Corn grain	88.29	7.81	12.72	13
Wheat bran	85.72	10.73	9.9	3.25
Maize bran	93.66	8.74	5.8	1.66
Barely bran	85.35	13.69	2.4	1.24
Mill sweeping	92.75	4.79	5.44	4.07

Sources: (26)

Table 4: Proximate composition of common fish feed ingredients reported by (26)

Fish feeding practices were three types from theses commercial feed feeding one of the new technology practices- specially research centers and investors at small scale. The second one was on farm formulated fish feed feeding practice which has future promising in aquaculture development in the countries and it is affordable and accessible. and the third one was more common feeding practice (ingredient powder fed of fish) which is nutritional poor but not expensive. This practice done through country side specially by fish farmers. Fish feeding practice dominated by (A) 0il seed by products, (B) wheat grain, wheat gluten meal and what bran, (C) fish waste meal /fish meal. Different researchers/ scholars practiced feeding of fish as powder widely compare to commercial feed and on farm formulated feed (Table 5).

Ingredients	% CP	Scholars
Fish meal	54.8 - 60.57	(28)
Formulated feed	32	(29)
Noug cake	31.2	(30)
Poultry manure	19.88	(31)
Cotton seed cake	38.34	(14)
Line seed cake	26.77	"
Sunflower cake	29	"
Sesame meal	43..48	"
Rape seed cake	37.8	"
Groundnut	54.17	"

Table 5: Fish feeding practice and protein contents reported in Ethiopia

3.1. Feed formulation

Feed formulation is the process of quantifying the number of feed ingredients that need to be combined to form a single uniform mixture for livestock, fishes and other animals to prepare animal feed in the industry. The formulated feeds provide various nutrients that are needed for the growth of animals. A good animal yield is highly dependent on the quality and safety of feeds supplied. Therefore, the formulated feed should provide a balanced diet for the animal with high-quality ingredients and adequate amount to provide healthier growth). One of the criteria for feed formulation is to make sure that all ingredients included in the recipe are safe from physical, chemical and biological contaminants. Feed formulation is done based on the class of the animal, feed ingredient types and constraints and cost and availability of ingredients. Formulation of animal ration is a complicated problem as, the requirement of animals varies with species, the stages of growth, body weight and physiological needs such as pregnancies, milk yield at certain level with different fat percentages [32]. Feed cost directly determines the profitability of animal farming since it accounts for most of the industry's expenses. In an attempt to economize the ration formulation, several mathematical models have been used with varying success. Some of the conventional

methods available are Pearson's square method and trial and error method [33].

Feed formulation was done by using least cost formulation application that uses linear programming. The formulation functions by utilizing Microsoft excel solver add in option. Excel is preferable since it is popular and widely available. It allows developing a feed from different ingredients that have various nutrient compositions in order to produce nutritious and affordable feeds. Least cost formulation is a way of balancing rations in a simple procedure that enables formulating feeds by entering the nutritional requirement of an animal for a specific nutrient. Feed combinations that can give the required nutritional value with the least possible cost values are selected.

Common fish feed formulation methods adopted in Ethiopia fish farmers

1. Pearson square method [34].

2. Trial and error method [35].

There are many fish feed ingredients and feeding practiced by farmers, researchers and private fish farms as powder and on farm formulated feeds. More than 98.7% of fish feeding practice e was as powder /unformulated feed but 1% was on farm formulated feeds and the rest 0.3% was commercial feed, the purpose of research conducts. In Ethiopia plant products and by products numerous than animal products and by product (Table 8). From 21 common ingredients fish meal, wheat bran, rice bran and Nuog cake were the dominant ingredients.

Alfalfa leaf	Haricot bean	Sesbania
Azolla	Lupine meal	Sesames cake
Blood & bone	Maize bran	Soybean meal
Brewery west	Noug seed cake	Sun flower meal
Cassava leaf	Pumpkin fruit	Sweet potato
Chicken manure/ droppings	Poultry manure	Tree Lucerne
Fish offal	Rice meal	Wheat bran

Table 8: Summary common fish feed ingredient s practices in Ethiopia

Ethiopia is rich agro-industry by products, specially crop by products and fresh water resources but aquaculture development in Ethiopia is at infant stage compared to Africa and East African countries. Egypt is one of the developed countries in aquaculture in Africa and also the first leading country but the water source is Nile River which coming from Ethiopia. From seven regions Amhara and Oromia region were very rich fish feed resources (oil by products) compare to others The lowest producers were SNNPR, Benishagul Gumuz and Harari (Table 6). Each oil seed production dry matter in tone was Noug cake (147,134), Linseed cake (17, 297), Groundnut cake (20, 510), Sunflowr cake (7, 444), Soybean cack (43, 150), Cotton seed cake (68,548,), Sesame cake (33, 072), Rape seed cake (7, 458), Mixed cake (1, 361) and Total 345, 974 (Table 6). The percentage of each oil seed cake was Noug cake (42.53%), Linseed cake (5%), Groundnut cake (5.93%), Sunflowr cake (21.5%), Soybean cack (12.47%), Cotton seed cake (19.81%), Sesame cake (9.56%) , Rape seed cake (2.61%), Mixed cake (0.39%). From theses oil seed Noug seed cake and cotton seed cake were the highest and the lowest were Rapsed cake, Sunflowr cake and mixed cake respectively (Table 6).

Oil by products	Adiss Ababa	Amhara	BG	Harari	Oromia	SSNNPR	Tigray
Noug cake	8.015	21,145	1,933		114,361	1,565	115
Linseed cake		8,274			9, 023		
Groundnut cake	124	2,758		7,819	9,809		84
Sunflowr cake		3,628			3,816		
Soybean cack		3,677			39,473		
Cotton seed cake	13592	24823			13, 997		16,136
Sesame cake		23903	170		3,869		4,130
Rape seed cake		3727		1,955	1,776		
Mixed cake					1361		
Total	**21,731**	**91,935**	**3,103**	**9,774**	**197,185**	**1,565**	**20381**

Table 6: Production and distribution of oil seed cakes in Ethiopia by region per year

BG (Benishangule Gumuz) and SNNPR (South people nation of nation region)

Source (36)

4. Fish feed resources, Fish feed formulation and feeding practice of fish in Ethiopia by different scholars

Feed A (37)
Supplementary feeding

Locally available fish feed ingredients were used feed formulation and fed fish during study. Mixture of mill sweeping, blood bone meal and oil seed cake were used in proportion of 60%, 20% and 20%, respectively. Feed s were pellet by using manual and electric meat grinder. Formulation of fish fed described in (Table)

Feed type	% Protein	Composition	Formulated feed protein content
Mill sweeping	11.9	60%	7.14
Blood & Bone meal	52.5	20%	10.5
Oil seed cake	17.1	20%	3.42
Premix	18.5	0	0
Total protein	100	100	21.06

Table 7: Fish Feed protein content ratio and formulation

Feed type	% protein	% Fat	%moisture	% fiber	%Ash
Mill sweeping	11.9	5.8	14	10.9	10.6
Blood & Bone meal	52.5	11.4	10.9	4.3	30.9
Oil seed cake	17.1	9.2	4.1	12.9	7.8

Feed B (38)

Locally available ingredients were brewery waste, Noug cake and wheat bran. The fish were fed on a composite mixture of wheat bran, brewery waste and Noug cake in powder form after mixing the ingredients fed fish showed (Table 9)

Ingredients	composition %	% protein
Brewery waste	40	11.6
Noug cake	51	14.79
Wheat bran	9	2.61
Total	100	29

Table 9: Proximate composition (dry weight basis) of locally available feeds

Feed C (39)

Researchers used Commercial feed (Alema kudijius pellet feed) for research purpose as a control group and compare to on farm formulated feeds which is affordable and cost effective. The feed proximate composition described (Table10)

Feed ingredients	Crude protein	Feed I CM	Feed II *SYB)	Feed II (EWB)
Earth worm	52.2	27		20
Soybean	44	-	20	-
Brewery waste	29	-	61.8	7.3
Wheat bran	18	-	18.2	72.7
Total protein		27	30	30

* Cm (commercial feed as Pellet)

Table 10: Percent composition of ingredients used to formulate farm-made and commercial feed used in the growth experiment.

Feed D (40)

Fish diets were prepared from locally available feeds. These were Oil seed cake (O), Mill sweeping (M), Rice bran (R) and Blood and Bone meal (B). Four combinations of feeds were prepared as diet-1 (ROM+B), diet-2 (RM+B), diet-3 (MO+B), and diet-4 (RO+B) (TABLE. 4)

Ingredients	Diet (%)			
	Ditet1	Diet2	Diet3	Diet4
Blood & Bone meal	20	20	20	20
Rice bran	20.67	20	-	20
Oil seed cake	20.67	20	40	40
Mill seeping	20.67	20	40	-

Table 11: Proportion (%) of different ingredients used in formulated diets

In all the diets, 20% of blood and bone meal was added to increase the protein composition and solve the Potassium (P) limitations which are major nutrient and mineral for fish growth, respectively. The analyzed average proximate nutritional compositions of diets used in this study were presented in (Table 12)

Feed type	Nutrient Composition percentage				
	Protein	Fat	Fiber	Ash	Moisture
Blood & bone meal	52.48	11.36	4.18	20.86	10.83
Rice bran	17.47	12.48	14.41	14.24	11.99
Mill sweeping	11.92	5.78	10.89	10.53	14.04
Oil seed cake	17.06	9.17	12.95	7.81	4.10

Table 12: Feed types used and their nutrient proximate composition

Figure 2: Pellet feed

Table 13. presents the supplementary feeds crude nutrients composition with respect to their dry matters. For all formulated feed diets, the crude nutrients analyzed by using Win feed 2.8 software. The mean dietary rude protein was 22.84%.

Treatments	Crude protein	Crude fat	Crude fiber	Dry mater
Diet1	22.87	13.2	16.1	89.43
Diet2	22.22	9.5	10.9	90.92
Diet3	22.00	8.2	10.3	90.00
Diet 4	24.28	10.9	11.7	87.4
Average	22.8425	10.45	12.25	89.44

Feed E (41)

Table 13: Proximate Composition percentage of each diet

The researchers formulated three different feeds to observe body weight change of fish and select the best one.1/ Feed one feed formulation contain 51% of wheat flour and 49% noug cake (WF+NC), Feed two contain 43 % of maize flour and 57 % of noug cake (MF+NC) and control feed was without any supplemental feed. Diet in the fed treatments had 21% of crude protein.

Three levels of fish feeds were formulated based on the percentage of crude protein (CP)). (Feed1) 30% CP, (Feed 2) 35% CP 40%, The proportions of the experimental feed ingredients, in the formulated feeds, were determined using the Pearson square method and algebraic equations, the most commonly used methods for balancing crude protein levels17 (Table 14).

Feed F (42). Feed formulation and processing

Ingredients	(Feed1) 30% CP		(Feed 2) 35% CP		(Feed3) 34% CP	
	%	%CP	%	%CP	%	%CP
Poultry manure	44.93	13.48	56.80	19.88	65.72	26.29
Wheat bran	23.3	6.99	29.49	10.32	34.10	13.64
Maize bran	14.27	4.28	6.14	2.15	0.08	0.03
Barely bran	17.5	5.25	7.57	2.65	0.1	0.04
Total	100	30.00	100	35.00	100	40

Table 14: Percent contribution of each ingredient to crude protein (%CP) for each formulated feed

Figure 4: feed processing and formulation

Feed G (43).

The diammonium phosphate (DAP), a chemical fertilizer, was added into the first six treatment ponds (T1) at a rate of 2 g m-2 week. The fertilizer was dissolved in the water from the ponds and disseminated over the same ponds. Similarly, poultry manure was added into the remaining six treatment ponds (T2) at the same rate as for the DAP. The manure was kept in pieces of sacks and suspended in the ponds waters to prevent direct feeding by the fishes. While the nitrogen and phosphorus concentrations of DAP were referred from the manufacturer's product description, the concentrations of these elements in the poultry manure used in the study were determined according to the proximate method of analysis

Feed I (44)

In general, there are promising nutritional and economic justifications for replacing fish meal by mixture of lupin and grass pea protein sources in the diets of Nile tilapia considering growth parameters, feed utilization, carcass composition, hematological parameters, and economic analysis up to 75% level.

Diet Formulation and preparation the feed ingredients of grass pea (Lathyrus sativus) and lupin (Lupinus albus) were bought from the local market in Addis Ababa (Mesalemia) whereas fish meal was prepared from whole fish purchased from the market with respect to the price presented in Table 5. Freshly collected whole fish was purchased from Lake Ziway, Ethiopia. The freshly collected whole fish was minced using an electrical meat miner and then dried in an oven for 24 hours at 72 oC. The dried fish carcass was ground into a fine fish powder using an electrical smashing machine, sieved (0.5mm mesh size sieve), and then stored in a plastic bag at -18 oC in a deep freeze.

Ingredients	Control diet	LG M25	LGM520LGM50	LGMS75
Fish meal	323	242.25	161.5	80.75
Wheat grain	120	120	120	120
Corn grain	109.8	109.8	109.8	109.8
Soybean grain	362.80	362.8	362.8	362.5
LGM	0	80.75	161.5	242.5
CMC	29..00	20	20	20
VMP	4.4	34	34.4	34
SBO	30	30		

Table 15. Composition of ingredients in diets (g Kg-1) in replacement of fish meal with a mixture of lupin and grass pea-meal

Note: LGM- lupin and grass pea mixture meal, SBO- Soybean oil LGM25 = 25% of fish meal replaced by lupin and grass pea mixture meal LGM50 = 50% of fish meal replaced by lupin and grass pea mixture me LGM75= 75% of fish meal replaced by lupin and grass pea mixture meal CMC = high viscosity carboxymethyl cellulose used as a binder

Figure 5: Feed processing and formulation in pellte form

Feed K (46)

Feed and feeding of the experimental fish were Formulated feed was purchased from Alema Koudijs's animal feed processing industry agent at Bahir Dar. The nutrient content of the feed is indicated in (Table 17)

Nutrient content	Measurement	Minimum	Maximum
Crude protein (cp)	%	35	-
Fiber	%	-	4
Fat	%	7	-
Calcium	%	2	-
Moisture	%	-	9
Carbohydrate	Kilo calorie	3540	-

Table: 17: The proximate composition (%) of the feed ingredients used during the experimental period.

Feed L (47)

Feed category	Protein	Lipid	Fiber	Ash	Dry matter
Rice bran	62.97	13.07	7.2	14.7	90.85
Wheat bran	14.84	9.71	6.12	8.96	90.1
Soy bean cake	42	3.5	6.2	6	89
Noug cake	32.89	7.72	21.3	-	93.2

Table 18. Nutrient composition of the locally available fish feeds in percentage

4. Growth Performance of Nile Tilapia in Ethiopia

In Ethiopia there were research works carried out on growth performance of Tilapia in different feeding systems in cage culture, earthen pond, aquarium and concrete ponds. Temperature, oxygen and pH were major critical factors that have great impacts on the growth of fishes. Temperature was recorded to the highest 25.05 and minimum 18 but the recommended temperature for Nile Tilapia is (25-32^0 C). In Ethiopia so many researchers were conducted on the growth performance of Tilapia (body weight gain (BWG), Daily growth rate (DGR) and others parameters but their findings not aliened international standards. In six months, Nile tilapia body weight recorded 300g but in the case of Ethiopia researcher reported below 180 g which is very low, the reason it might be quality feed problems and not managed properly. Fish feed might be easily sink in the water bottom which cause nutrient loading and cause oxygen deficient. When water temperature drops below 21°C, the Tilapia growth slows dramatically, reproduction stops and the incidence of disease increases.

Temperature	Feeding
TO <10^{0}C	No feeding
14 - 15^{0}C.	1 time/day
18 - 20^{0}C	1 - 2 times/day
20 - 30^{0}C,	3 - 4 times/day
> 31^{0}C,	1 - 2 times/day

Source: (48)

Table 19: Factors affecting of Tilapia growth in pond

Maximum Tilapia daily growth rate was reported 1.3 to 1.6g by (5) which is greater than Ethiopian research findings (maximum and minimum were 0.8 and 0.1g respectively (Table20). More researches conducted earthen and concrete pond rather than cage and aquarium. Feeding of fish in Ethiopia reported two time per a day which was reported al scholars but number of feeds were varied. On farm formulated feed was commune fish feed in Ethiopia which is very important to minimize cost and increasing production and easily afford it. Formulated feed from (37-46) fish ate the feed and what they performed showed (Table 20).

Parameters	Growth performance of Nile Tilapia reported by Scholars in Ethiopia									
	37	38	39	40	41	42	43	44	45	46
IW (g)	43.61	46.35	28.3	42.5	33.3		20.9	1.37	19.64	8.57
FW (g)	118.9	76.7	66.31	177.	72.18	46.63	51.33	9.14	166.49	179.7
DGR (g)	0.75.	0.2	0.32	0.63	0.35	0.56	0.15	0.1	0.81	0.62
Stock density/m^2	47	50/C	2	100/C	3	2	2	23	5	4
Fed%/day	3	2	3	3	5	8	3	8	4	5
Feed type	Pt	For	Pt	Pt	For	For	Pm	Fr	Pt	pw
Feeding time/ day	2	2	2	2	2	2	2	2	2	2
Months	3.33	6	6	6	7	5	5	2.5	6	10
Culture type	Cage	cage	pond	Cage	Pond	Pond	pond	RC	pond	pond

* IW (initial weight g) and FW (Final weight g)

Conclusion

There are three types of fish feeding practice in Ethiopia (commercial feed, on farm formulated feed and (ingredients as powder). The most affordable and cost-effective fish feed was on farm formulated feed. Ethiopia is rich fish feed resources but not efficiently utilize the resources properly. Plants were the highest dominate in fish feeding practice compare to animal products in Ethiopia. On farm fish feed formulation and feeding practice was not well grew due to this reason aquaculture is found infant stage in Ethiopia compare to East Africa countries. Growth performance of Nile Tilapia was very low, in six to ten months, the body weight of Tilapia reported below (180 g). Sources of seed was wild fish and mixed sexes) which is not advisable in aquaculture development in the present day. Aquaculture management practice was poor in Ethiopia (there was no quality seed (mono-sex fingerlings), quality feed and promising market. The contribution of aquaculture in Ethiopia economy was very little bit. The daily growth rate of Tilapia highly difference in Ethiopia, highest and lowest reported 0.81g and 0.1g respectively but average 0.42g which is very low compare with international daily growth rate standard. The expansion of agro-industry in Ethiopia are good opportunities for affordable fish feed formulation and growth of aquaculture in the country.

5.1. Recommendation

To develop aquaculture in Ethiopia, advanced seed multiplication center established and fish feed processing plants will be developed and manually feed processing machine also distributed for fish farmers. On farm feed processing and formulation practice will be given training for fish farmers and experts. Now a day, Tilapia production in open water is reduced 60% to 49 % so aquaculture is the best solution to poverty reduction in Ethiopia. From three feeding system on farm formulated fish feed will be expanded rather than commercial feed and powdered feed.

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