E-ISSN: 2347-5129
P-ISSN: 2394-0506
(ICV-Poland) Impact Value: 5.62
(GIF) Impact Factor: 0.549
IJFAS 2017; 5(2): 562-565

www.fisheriesjournal.com
Received: 11-01-2017
Accepted: 12-02-2017

Lemma Abera Hirpo
Zwai Fishery Resource Research Center, P.O. Box 229

Correspondence
Lemma Abera Hirpo
Zwai Fishery Resource Research Center, P.O. Box 229

Evaluation of integrated poultry-fish-horticulture production in Arsi Zone, Ethiopia

Lemma Abera Hirpo

Abstract
The study was conducted in Arsi Zone, situated about 175 km away from the south east of Addis Ababa, and the objectives were the production evaluation of integrated system of poultry-fish-horticulture. Poultry breeds of Rhode Island Red which was dual purpose for egg and meat production, fish species (Oreochromis niloticus) and different varieties of horticultural crops viz. Bombe red onion (Allium cepa), variety of Malkashola Tomato (Lycopersicon esculentum) and Cabbage (Brassica oleracea) were investigated. The data were collected over a period of November 2009 to August 2011. The production of the integrated system was high as compared to the non-integrated ones. The fish production was positively improved due to the presence of poultry manure and wastes in water that served as fertilizer for horticultural production.

Keywords: Horticulture crops, integration, oreochromis niloticus, poultry manure

1. Introduction
Ethiopia has a large population of domestic animals (Cattle, sheep, goat, etc.) for protein sources. In addition to increasing protein production from terrestrial animal resources, effort should be made to look fish population found in the country's freshwaters. Hence, the country is endowed with several productive freshwater (Lakes and rivers) and results of various studies indicate that the number of fish species could increase to 200 and above [6]. Capture fisheries is very common in most part of the country, especially around mid rift valley as a result fish production is highly exploited due to open access to the resources.

This justifies the need of the development of alternative aquaculture with integrated farm in such areas to meet consumers demand. Therefore, the present economic pressure for maximizing food production and minimizing production cost with a general concern for energy conservation has led to an approach of integrating fish farming with animal husbandry and horticulture. Since, the integration of fish culture with livestock or cash crops holds a considerable potential for augmenting production of different commodities, generation of employment opportunities in the rural areas and improvement of socio-economic condition of the farmer.

In addition, integrated fish-livestock-horticulture farming is a practice which links together the three normally separate farming systems, whereby the livestock, horticulture and fish become subsystems of a whole farming system. Emphasis focuses on an optimal waste or by-product utilization efficiency in which the waste of one subsystem becomes an input to the other subsystem. The integration of livestock and horticulture with aquaculture has received considerable attention lately with emphasis on the incorporation of animal manures as fertilizer and nutrient for the promotion of natural feed in fish ponds [3]. Integrated farming activity is a multi-commodity farming system with the waste recycling as the key feature and fish culture as the major activity.

Thus, there is a need to find a suitable agricultural system to meet the increasing demand for food, and also maximize the utilization of the available limited resources without much wastage and the general objective of the paper was therefore to evaluate the production performance of fish, poultry and horticulture in the integrated farming system in the area.

2. Methodology

2.1 Description of study area

The study area was located $08^{0}04.6000$'N and $038^{0}53.509$'E in Arsi Zone, Sheled Goto Peasant association, 175 km south east of Addis Ababa. The area is located at an altitude of 1700 meter above sea level. Kater River is the main water resources that transect the area and drain to Lake Zwai.

2.2 Farmer selection

The experiment was started in January 2009 and was completed in June 2011. A number of formal and informal discussions were conducted with the beneficiaries, development agents and local government officials to select farmer purposively. There were various factors that considered in farmer selection. Some of these factors were attention to physical factors, including environmental conditions of the farm area (source of water supply, water quality, type of soil, weather, etc.), suitability of the integrated components species of fish, breeds of poultry and varieties of horticultural crop and availability of other inputs.

2.3 Poultry production

Poultry house constructed on the top of the pond. Dual purpose of poultry breed was used for integration purpose, i.e Rhode Island Red breed. 2:14 sex ratio of male to female was assign for production of egg and manure. This breed was also known for its adaptability of the selected agro ecological zones. As a management, supplementary feed was formulated from locally available different ingredients and the ration was formulated as described in table 1.

Table 1: Ingredients and amounts used for ration formulation of the poultry

Ingredient	Amount (Kg)	
	Grower	Layer
Wheat	2	2
Maize	33	40
Wheat bran	12	15
Wheat middling	40	12
Nug cake	5	20
Fish meal	-	5
Oat	6	-
Limestone	1	5
Salt	0.5	0.5
Bone meal	0.5	0.5
Total	100	100

Feeding rate was described in table 2 and information on growth rate and environmental monitoring as well as health inspection of the poultry was undertaken regularly. Information on the volume of manure per animal and the relation between fish yield and manure load is available in table 2.

Table 2: Age of poultry and feeding rate

Age (week)	Feeding rate (gr/day/bird)
0-8 (Starter)	-
9-20 (Grower)	80 – 110
>20 (Layer)	110 – 120

The manure was directly dropped in the fish pond as supplementary feed.

2.4 Fish production

An earthen pond having an area of $72m^2$ with 5% sloppy was constructed in the connection of the main canal of irrigation drainage system. All the necessary preparation and treatment for plankton induction was accomplished for the production of fish. A total of 216 fingerlings of *Oreochromis niloticus* were collected by using beach seine hauls from Lake Hora. The range of individual total weight of the fish was 30-40g. All necessary managements were undertaken up to harvested period of 24 weeks were recorded.

2.5 Horticultures production

The land was cleared, ploughs and prepared for vegetable before transplantation of the horticultural crops. Bombe red onion (*Allium cepa*), variety of Malkashola Tomato (*Lycopersicon esculentum*) and Cabbage *(Brassica oleracea)* were prepared on bedding. Then each seedling was transplanted according to their recommendation set for each crop. Transplanting were conducted after two months of fish stocking time and carried out simultaneously with fish raising period. These varieties were selected based on market demand, earliness of maturity and high yield performance in the given area. All crops were grouped into two (Pond and river water). Within the group there were two treatments for each horticultural crop and the treatments were elaborated as follow:

Group I

T_{11}=River water (water not in the integration system) + *the three variety of horticultural crop* - Control

T_{12} = T_{11} + recommend inorganic fertilizer + *the three variety of horticultural crop*

Group II

T_{21}=Pond water (water in the integration system) + *the three variety of horticultural crop* - Control

T_{21}=T_{21} + recommended inorganic fertilizer + *the three variety of horticultural crop*

During transplanting, the amounts of fertilizers that added to each treatment were based on the recommended ratio of the application. Other managerial horticulture activities were conducted throughout the experimental period (up to harvesting) and also some water and soil parameters were assessed and analyzed from the experimental plots, river and pond.

2.6 Statistical analysis

The experiment was conducted using randomized complete block design (RCBD) using the block namely direct river water and pond water with replication of three times on 3m x 4m for all variety of horticultural crop. Data were analyzed using General Linear Model of Statistical Analysis system.

3. Result and Discussion

3.1 Egg production and Poultry waste characteristics

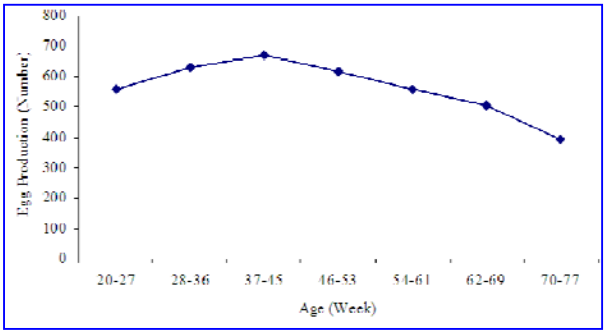

Fig 1: Egg productions in relation to age of the chicken

The poultry start to lay eggs on 22 weeks with the range of 10 to 15 eggs per day and with the mean of 12 from the total flock (Fig. 1). The study showed that egg laying becomes uneconomical after chickens reach the age of 18 months because the production was decreased due to in relation to physiological change of the bird

The chemical composition of the manure was nutrient-rich, but there is great variability in their quality at the time of use as fish production inputs. Species, size and sex of poultry directly affected the quantity of manure produced. The amount of feed spill during feeding and drinking also varies with these factors together with the nature of the feed and feeding practice. Generally, larger birds produced more waste than small and layers produced more calcium and phosphorous-rich excreta than broilers (Table 3).

Table 3: Mean Calcium and Phosphorus Content (on DM)

Type of Waste	Ca	P	Ratio P:Ca
Broiler manure	1.9	1.7	1 : 1.1
Layer manure	7.5	2.6	1 : 2.9

3.2 Fish production

The final weight of the fish ranged from 65.7 to 225 gram, with an average of 147 gram within seven months. In the experiment, males were bigger than females. This is due to physiological characteristics of the fish.Tilapia males grow faster than females and they are mostly bigger at the same age. The result of this study on the growth performance fish was economically acceptable as compared to those studies that reared in earthen ponds supplemented with different feeds [13]. In aquaculture poultry waste has been recycled as fertilizer for centuries with the aim of promoting pond productivity of phyto-and zooplankton. In addition poultry has short digestive tract, 80% of chicken manure represents undigested feed stuffs [2]. In integrated poultry fish farming, the protein rich chicken dropping was made available to the fish either directly or indirectly via the primary producers in the aquatic food web [7], which in most cases reflects the productive capacity of the ponds.

Since the system was integration manure loading in integrated fish farming basically comes from poultry farm animals, which contain considerable quantities of nutrients for fish production. Protein content from manure of the same breed of layer ranges between 10 - 30%, energy between 110 - 1400 kcal per kg manure with synthesized soluble vitamins in high concentration [9]. It also contains non digested feed. Metabolic excretory products and residues resulting in microbial synthesis which can be utilized to replace reasonable parts of feed stuff used in conventional fish production cost [4, 5]. According to [14] the effect of manure produced in integrated fish farming depends on the species of the animal involved.

It is observed that the manure added to fish ponds as feed give better result than fertilizing the pond and also vary in their efficiency to produce fish biomass [1]. According to [8] the number of farm animals should be directly related to the manure loading that the fish would require. [10] reported on the benefit of manure in the production of benthic organisms, and indicated also, that *tilapia* hybrid ingests manure directly.

3.3 Horticulture production

The yield obtained from the two group (yield obtained in connection with integrated farming system and without) were separately analyzed and swap over to the yield per hectare (Table 4, 5 and 6)

Table 4: Yield of *Brassica oleracea* in the two groups

Treatment	Average yield from plots Kg/m^2	Estimated yield (q/ha)	P-value
T_{11} (River water only)	0.99±0.02	98.85	0.0003
T_{21} (Pond water only)	2.22±0.03	221.83	
T_{12} (T11 + inorganic fer)	2.1±0.0.05	210.42	
T_{22} (T21 + inorganic fer)	2.36±0.06	236.34	0.3720

The difference in the yield of *B. oleracea*, *A.cepa* and *L. esculentum* between T_{11} and T_{21} were highly significant at ($P < 0.05$) as indicated in Table 4, 5, and 6. Even thought there was no significant difference at ($P > 0.05$) between the yield of T_{12} and T_{22} for all varieties of horticultural crops, at least there were quintals variation existed between the treatments. [11] also confirmed this result on his study of integrated fish-horticulture farm at Taltale in Debrelibanos, North Shoa Zone of Oromia.

Table 5: Yield of *Allium cepa* in the two groups

Treatment	Average yield from plots Kg/m^2	Estimated yield (q/ha)	P-value
T_{11} (River water only)	1.66±0.02	165.67	0.0002
T_{21} (Pond water only)	3.72±0.06	371.6	
T_{12} (T11 + inorganic fer)	3.55±0.03	355.31	0.421
T_{22} (T21 + inorganic fer)	3.81±0.025	381.4	

The comparative yields of the treatments T_{12} and T_{22} with T_{21} for *A. cepa* were due to application of inorganic fertilizer. This result supports the reports of [11] for the production of the crops.

Table 6: Yield of *Lycopersicon esculentum* in the two groups

Treatment	Average yield from plots Kg/m^2	Estimated yield (q/ha)	P-value
T_{11} (River water only)	1.72±0.01	171.5	0.0002
T_{12} (T11 + inorganic fer)	4.58±0.05	458.32	
T_{21} (Pond water only)	4.69±0.08	469.14	0.634
T_{22} (T21 + inorganic fer)	4.77±0.02	476.61	

4. Conclusion and Recommendation

Integrated fish farming profitable than unitary system of farming because of its diversify nature in rearing of fish, animals and crops. It has a capacity of making more food available, thus enhancing food security and creating more jobs for the teeming unemployed masses in the country.

Standard dose feeding culture should be implored in fishery management, as this would keep the physicochemical parameters of pond water in a favourable range required for the survival and growth of fish. The indiscriminate use of manure in fish ponds instead of improving the pond productivity, may also lead to pollution.

Hence, the study confirms that is profitable it needs to demonstrate integrated farming system as one strategy that can be adopted by small farmers in the country to increase farm returns from per unit area of land. Moreover, integrated farming is a way by which a farmer insures himself against the risk of falling into crises of subsistence since he is able to spread the risk of production over several activities. Because animal and fish production activities are not usually characterized by co-variant risks, the farmer is able to stabilize inter temporal flow of total daily incomes. Integrated farming facilitates productive use and recycling of wastes. Finally, this study focused on horizontal production of poultry, further investigation is required to investigate vertical integration of poultry production in the system for better profit.

5. References

1. Ansa EJ. Effect of pig Manure on the growth of *Oreochromis niloticus* under integrated Fish cum-pig farming system. J. Aqua. Sci. 2002; 17(2):85-87.
2. Chen FY. Chicken Farming in integrated fish farming Regional Aquaculture, Center Wuxi China. NACA Technical Manual. 1989; 11:4-30.
3. Delmendo. Contribution a la connaissance des crustaces Copepodes d' Ethiopia. *Hydrobiol.* 1980; 164:103-147.
4. Falayi BA. Inclusion to poultry manure in a complete ratio for *Tilapia O. niloticus* fingerlings. Project submitted to the dept. of fishers and wild life fed unit tech Akure. In partial fulfillment OF P.GD Awards in Wild Life and Fisheries. 1998, 14-17.
5. Fashakin EA, Falayi BA, Eyo AA. Inclusion of poultry manure in a complete feed for *Tilapia O. niloticus* fingerlings. J. Fisheries Technol. 2002; 2:51-56.
6. JERBE. Fish diversity in the main drainage systems of Ethiopia. Addis Ababa, Ethiopia. Unpublished manuscript. 2007.
7. Oladosu GA, Ayinla OA, Onuoha GC, Mecdom JG. Performance of *Clarias gariepinus* in a polyculture with *Orechromis niloticus* under the integrated broiler chicken fish farming. NIOMR Technical/paper. 1990, 65.
8. Otubusin SO. Pronosed integrated guinea fowl cum fish culture in Lake Kaiinji. In: JSO Ayeni (ed). Helmited guinea fowl (NMGP) in Pearl HW, Tucker OS. Ecology of blue green algae in aquaculture ponds. J. World Aquacult. Soc. 1995; 26(2):109-131.
9. Praff PF. Utilization of Animal manure and sewage Sludges in food and fiber production. Agric. Sci. Technol. 1975; 3(3):23-25.
10. Smitherman RO, William JC. Production of Tilapia Hybrids with cattle manure as diet in fish culture. Oxford University Press Oxford. 1977, 43-54.
11. Tugei D, Nagisho T. Integrated fish-horticulture farm at Taltale in Debrelibanos, North Shoa Zone, Oromia, Ethiopia. In: Impact of climate chang and population on tropical aquatic resources, proceedings of the 3rd International Conference of Ethiopian Fisheries and Aquatic Science Association (EFASA), editors:Brook Lemma and Abebe Getahun. AAU Printing Press, Addis Ababa. 2011, 141-150.
12. Tuleun CD. The utilization of heat treated poultry manure in chicks diets. Paper presented at the 17th annual conference of the N.S.A.P Abuja 23rd - 27th March, 1992, 8.
13. Velasquez CC. Health constraints to integrated animal fish farming in the Philippines. In: Rogers S.U, Pulins and Zrad H (eds). Integrated Aquaculture farming systems ICLARM- 58A RCA Manilla Philippines. 1980, 103-111.
14. Yingzue F, Xianzten G, Jikun W, Xiuzherg F, Zhinyna L. Effect of different animal manure in fish farming.. In: Maclean, JL, Dixon LB, and Hosillos LV (eds). First Asia Fisheries Forum. The Asian Fisheries Society, Manila, Philippines. Wohlfarth and Schroeder, Use of manure in fish farming-a review. Agricultural Wastes. 1979, 1986; 1:117-120, 279-299.