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Profitability of integrated culture of small indigenous species of fish (SIS) with rabbit and goat in homestead ponds

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Abstract: A study was conducted in twelve ponds of BAU Fisheries Field Complex and in the village Kismat Barenga under Netrokona district to evaluate the growth, production and profitability of small indigenous species of fish (SIS) and livestock in a SIS-livestock integrated system. The experiment was conducted for a period of 136 days during 4 July to 16 November, 2008. The treatments were MDR (Mola, dhela and rabbit), MDG (Mola, dhela and goat), MDRG (Mola, dhela, rabbit and goat), KSMR (Koi, shing, magur and rabbit), KSMG (Koi, shing, magur and goat) and KSMRG (Koi, shing, magur, rabbit and goat). The ponds under first three treatments were stocked with 13 mola and 12 dhela of 1 g size m^{-2} and 10 rabbits of 3 months old $40m^{-2}$, 2 she-goats of six months and 1 goat and 5 rabbits, respectively. The latter three treatments were stocked with 2 koi, 5 shing and 5 magur of 3 g size m^{-2} and with same number of livestocks as in first three treatments. Each goat was fed daily with 50 g wheat bran, 10 g molasses and 5 g salt and roughage with average six hours grazing a day. Rabbits were supplemented with locally available diet containing protein (15.4%) at 5% bw per day. with average 10 hours daily grazing. No feed was used for SIS. The highest fish production obtained in MDR (2.25 kg dec^{-1}) followed by MDRG (1.99 kg dec^{-1}) and MDG (1.44 kg dec^{-1}). On the other hand, the highest production of fish was in KSMR (5.28 kg dec^{-1}) followed by KSMRG (4.31 kg dec^{-1}) and KSMG (4.23 kg dec^{-1}). On an average a goat and a rabbit produced 420.3 g day^{-1} and 84.7 g day^{-1} dung, respectively. Mean harvest weight of rabbit was nearly 200 g higher in MDR and KSMR compared to MDRG and KSMRG. The highest profit margin dec^{-1} was observed in KSMR (82%) followed by MDR (68%), MDRG (64%) and MDG (56%). Integrated farming is highly profitable and rabbit –SIS integration is more suitable than goat-SIS integration especially for poor farmers.
Key words: Small indigenous species of fish (SIS), rabbit, goat, production and profitability.

Introduction

Bangladesh is one of the most populous countries of the world with more than140 million people. Despite increased level of food production, the country has long been suffering from malnutrition, especially animal protein malnutrition. On the other hand, people of the country continue to suffer from the lack of food. The problem further deepens from the last couple of years due to global economic recession as well as consecutive natural disasters. To address the food shortage and economic uncertainty of the hungry millions, development of a sustainable farm culture system is the challenge of the time. Generally, farmers in Bangladesh grow food grains, fruits and vegetables in their land. They also keep cattle and poultry birds and raise fish in their ponds traditionally. The fish is the core source of animal protein, which contributes 63% of the total animal protein. Per capita per day intake of fish protein is 37 g (DoF, 2003) against the standard requirement of 49 g. However, there is no interlinking between the farming components. Integration of these components can develop a revolutionary farming model where wastage or by-product of one subsystem can be used as input to another subsystem. The promotion of integrated farming systems may help in alleviating the food crisis (Edwards, 1986). Integrated livestock-fish farming is the recycling of animal wastes (faces, urine, and spoiled feeds) to serve as fertilizers, and sometimes as food for fish in the ponds. The pond water serves as a waste treatment system for the otherwise polluting manures (Edwards *et al.*, 1988). Now Bangladesh is passing a time of severe fertilizer crisis. Therefore, in prevailing socio-economic conditions dung of livestocks may be used to fertilize the ponds, at low cost, and to make the SIS and other fish culture feasible. Integrated culture of fish with either chicken or duck substantially decreased the production cost and increased fish production with an extra crop of domestic animals which can give 30-40% more profit than the conventional fish monoculture (Hussain and Mazid, 2001).

The animals that feed on lower level of food chain require low input cost which is particularly important for rural poor farmer. Culturing low-input animals not only improves the nutritional status of rural households, it also generates income. The contribution of fish to the food security in rural Bangladesh is important because fish is the single most important animal food in the diet (IFPRI, 1998). In rural Bangladesh, culturing mola (*Amblypharyngodon mola*) and dhela (*Osteobrama cotio cotio*) (feed on algae, zooplankton and detritus), *koi* (*Anabus testudineus*), *shing* (*Heteropneustes fossilis*) and *magur* (*Clarias batrachus*) (feed on insects, zooplankton and detritus) and domestic animals like - Black-Bengal goat, *Capra hircus* and rabbit, *Oryctolagus cuniculus* (feed on grass and other vegetation mainly) requires very low input but fetch a high market value. The present research was conducted to evaluate the potential of integrated culture aiming to develop a sustainable integrated homestead culture system comparing the growth, survival, final yield and economic return from different culture systems.

Materials and Methods

Study site and duration: A study was carried out having twelve ponds (average size 3-5 dec) in the Field laboratory complex, Faculty of Fisheries, Bangladesh Agricultural University, and in the village Kismat Barenga of Purbadhala under Netrokona district. The study was carried out for a period of 136 days during 4 July to 16 November, 2008.

Goat and rabbit management: The goat shades and rabbit cages were built on the dike of the ponds using locally available bamboo, wood and tin. The floor area of shade for two goats was 4.5 m^2. There were cemented inlets from goat shade to the ponds to allow manure to go to the ponds directly. The size for each rabbit cage was 0.125 m^3 (0.5 ×0.5 × 0.5). Cages were prepared with

bamboo splits in such a way that manure and other organic waste falls through the floor into the pond. One rabbit was placed in a single cage. A week before the SIS fingerling stocking, goats and rabbits were introduced to the shades and cages. Each goat was fed a maximum of 50 g wheat bran, 10 g molasses and 5 g salt per day, as well as roughage (made from locally available different leaves) with average six hours grazing a day. The new born goats during study were supplemented with half of the diet of adult goat. The goat was regularly dewormed. Rabbits were supplemented with locally available diet containing very low crude protein (15.4%) at the rate of 5% bw. with average 10 hours grazing per day. The new goat and rabbit were kept with their mother for three and two months, respectively and then were sold to the farmers.

Pond Management: Ponds were dried and repaired. On the dried pond bottom lime were applied at the rate of 1.5 kg d^{-1}. After a couple of days ponds were filled with water. SIS fingerlings were released into the ponds after one week of the introduction of goats and rabbits. The detailed experimental design is presented in Table 1.

Each pond was separated with net fence to prevent goats and rabbits to moving outside of their boundaries. Water depth was maintained 1.5 m throughout the study. No feed was used for SIS fingerlings.

Table 1. The detail experimental design for SIS and rabbit-goat integration system

Treatment	Mode	SIS and Number	Animals
MDR	Mola, dhela and rabbit	13 Mola + 12 Dhela m^{-2}; size 1 g	10 rabbits $40m^{-2}$; age 3 months
MDG	Mola, dhela and goat	13 Mola + 12 Dhela m^{-2}; size 1 g	2 she-goats $40m^{-2}$; age 6 months
MDRG	Mola,dhela, rabbit and goat	13 Mola + 12 Dhela m^{-2}; size 1 g	1 she-goat + 5 rabbits $40m^{-2}$
KSMR	Koi, shing, magur and rabbit	2 Koi + 5 Shing + 5 Magur m^{-2}; 3 g	10 rabbits $40m^{-2}$; age 3 months
KSMG	Koi, shing, magur and goat	2 Koi + 5 Shing + 5 Magur m^{-2}; 3g	2 she-goats $40m^{-2}$; age 6 months
KSMRG	Koi, shing, magur, rabbit and goat	2 Koi + 5 Shing + 5 Magur m^{-2}; 3g	1 she-goat + 5 rabbits $40m^{-2}$

Results and Discussion

Fish Production: Among the treatments with mola and dhela, the highest per decimal fish production obtained in MDR (2.25 kg dec^{-1}) where mola and dhela were cultured with rabbit followed by MDRG (1.99 kg dec^{-1} mola and dhela with rabbit and goat). The least production was found in MDG (1.44 kg dec^{-1}) where goat was integrated with mola and dhela. In case of the three treatments with *koi*, *shing* and *magur*, the highest per decimal fish production was found in KSMR (5.28 kg dec^{-1}) where *koi*, *magur* and *shing* were cultured with only rabbit (Fig.1). The production attained 4.23 and 4.31 kg d^{-1} in KSMG and KSMRG, respectively which were insignificant (P<0.05). Kohinoor (2000) reported that mola contributed 1.63 kg dec^{-1} in a polyculture system with carps. The higher fish production in the treatments where fish is cultured with only rabbit proved that the rabbit dung as pond manure was more effective than goat dung. A suitable integrated culture technique with compatible small indigenous species may exert synergistic effects in the integrated culture thus enhance fish production (Milstein, 1992).

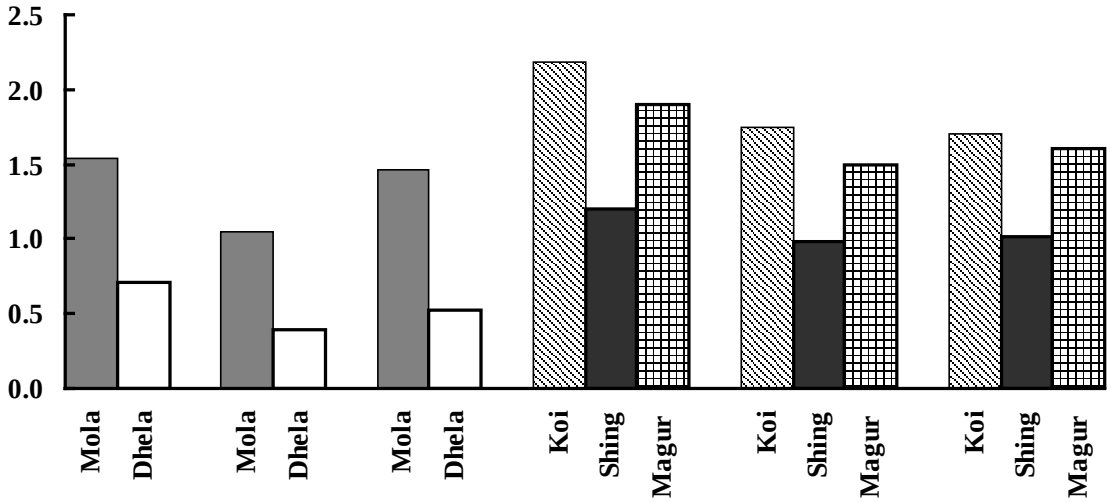

Fig. 1. Fish production kg dec^{-1} in six treatments

Production of dung by goat and rabbit: On an average a goat and a rabbit produced 420.3 g day^{-1} and 84.7 g day^{-1} dung, respectively. Therefore, regarding the amount of manure 10 rabbits produced nearly same amount of manure as produced by two goats. However, rabbit dung contained much higher amount of nitrogen and phosphorus – the two key nutrients for pond water compared to goat dung (Fig.2).

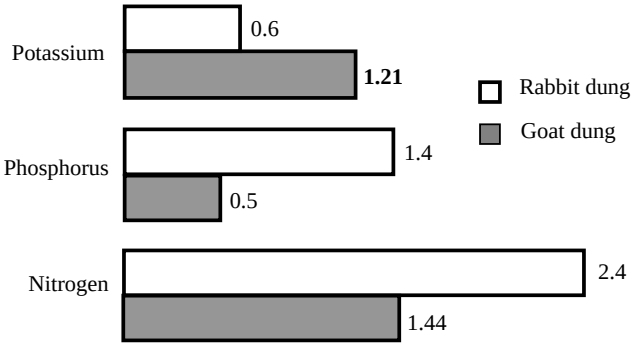

Fig. 2. Presence (%) of the three main nutrients - Nitrogen (N), phosphorus (P) and potassium (K) in goat and rabbit dung

Rabbit production: The growth increment of rabbit reared under the experiment was satisfactory in all the treatments (Table 2). The individual mean weight of the rabbit during stocking was 583 ± 78 g, after five months of rearing, individual mean harvest weight was 1,944 ± 133 g. However, the individual mean harvest weight of rabbit (2,043 g) in the treatments where only rabbits were integrated with fish (MDR and KSMR) was nearly 200 g higher compared to the rabbit weight (1,844 g) in the treatments where both rabbit and goats were integrated with fish (MDRG and KSMRG) (Fig. 3).

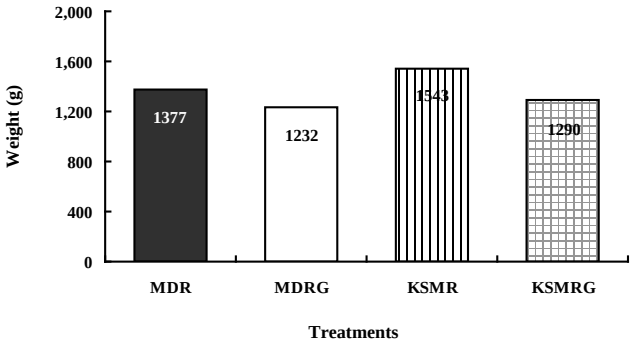

Fig. 3. Individual weight increase (g) of rabbit in four treatments in five months (MDR: Mola-dhela -rabbit, MDRG: Mola-dhela-rabbit-goat, KSMR: Koi-shing-magur-rabbit and KSMRG: Koi-shing-magur rabbit-goat)

Table 2. Individual mean weight (g) of rabbit in four treatments

	Individual Mean Weight g										
	29/06	14/07	29/07	13/08	28/08	13/09	29/09	14/10	29/10	14/11	29/11
MDR	573	706	863	1037	1204	1348	1501	1654	1759	1856	2012
MDR	537	690	837	1003	1160	1320	1483	1625	1748	1835	1909
MDRG	439	618	791	962	1112	1246	1398	1505	1606	1706	1803
MDRG	671	724	867	916	1053	1197	1327	1468	1583	1715	1828
KSMR	622	795	965	1133	1308	1484	1650	1784	1925	2060	2166
KSMR	591	752	911	1084	1257	1418	1570	1709	1842	1968	2086
KSMRG	555	702	849	1004	1160	1316	1472	1616	1736	1844	1921
KSMRG	680	725	863	913	1050	1204	1330	1462	1587	1720	1826

Financial analysis

Among the three treatments with mola and dhela, the highest per decimal profit margin observed in MDR (68%) where mola and dhela were cultured with rabbit followed by MDRG (64% mola and dhela with rabbit and goat) and MDG (56%) where goat was integrated with mola and dhela (Table 3). In case of the three treatments with *koi*, *shing* and *magur*, the highest per decimal profit margin obtained in KSMR (82%) where *koi*, *shing* and *magur* were cultured with rabbit. Per decimal input cost with rabbit integration were much lower than the treatments where goats were integrated (Fig.4). Though goat integration gave better profit in monitory value, however, profit margin (%) was the highest only in rabbit integrated treatment. This is particularly important for the poor farmers who do not have enough money to buy goats in integrated livestock-fish culture. They, however, can easily buy rabbits much cheaper.

Culturing *koi*, *shing* and *magur* gave slightly better profit than mola-dhela culture. From the nutritional point of view, specially when one consider the nutritional aspects, consuming *mola* and *dhela* always gave better nutrition than *koi*, *shing* and *magur*.

Table 3. Cost-benefit analysis (per decimal) of the six treatments in five months

Cost and return on item	Price (BDT dec^{-1})					
	MDR	MDG	MDRG	KSMR	KSMG	KSMRG
Input cost						
Labour	260	329	421	260	329	421
Animal – goat & rabbit	900	4450	3350	900	4500	3350
Animal shed	1500	1000	1300	1500	1000	1300
Fingerlings	55	55	55	146	146	146
Fish feed	51	50	52	123	124	123
Other	225	374	267	212	356	345
Total input cost	2991	6258	5445	3141	6455	5685
Financial return						
Fish sale	456	287	395	1077	863	885
Animal sale	4555	9500	8550	4650	9550	8500
Net profit margins	2020	3529	3500	2586	3958	3700
Profit margins (%)	68	56	64	82	61	65

BDT 70 = 1 USD

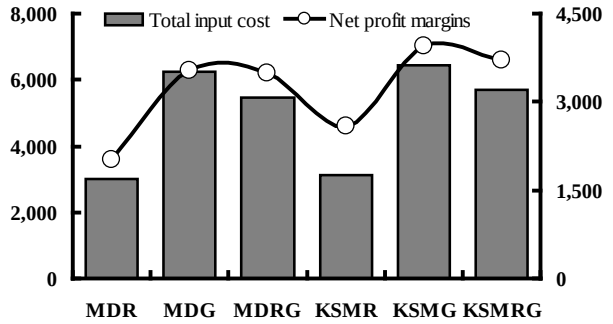

Fig. 4. Input cost and net profit per decimal in six treatments in five months

As we know that there is a national crisis of inorganic fertilizer country wide. Therefore, alternative use of organic fertilizer will minimize the scarcity of inorganic fertilizer and reduce environmental hazards. Following the integrated SIS-livestock culture, the rural poor can earn a substantial amount of money to improve their livelihood from their homestead farms. At the same time it will reduce the malnutrition of the poor family members. The findings of this study indicated that integrated farming is highly profitable and rabbit –SIS integration is more suitable than goat-SIS integration especially for poor farmers. This type of integrated culture will not only increase the benefit cost ratio compare to traditionally practiced animal mono-culture, it will also enhance the nutritional uptake at the household level and ensure more environment-friendly culture systems through nutrient recycling in a proper way.

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