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Short Communication

SWINE-FISH INTEGRATION: EFFECT ON CULTURE PERFORMANCE OF *CTENOPHARYNGODON IDELLA* AND *CYPRINUS CARPIO*

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ABSTRACT: The study compared the growth performance of *Ctenopharyngodon Idella* and Cyprinus *carpio* cultured under conventional management and integration of fish swine farming intended to optimize the biomass production from unit land in subtropical agro-ecosystem. The carp culture was integrated with swine production, where swine excreta was drained directly to the pond. The fishes in both treatments were fed thrice a day with locally formulated feed as a supplement at the rate of 2% wet body weight of fish fingerlings during the study period. The growth performance of carp fish in T_1 (111.80 ± 10.07 g) was higher than T_2 of 74.48 ± 6.29 g, and found significantly different ($p < 0.05$). In addition, this study although not significantly different the survival rate was found comparatively higher in fish swine integrated pond. The total fish production recorded was 3155.79 and 2076.42 kg/ha in fish swine integration system and conventional management, respectively. This study concludes that swine fish integration is feasible in subtropical area and there are possibilities to enhanced unit fish production.

Keywords: *Ctenopharyngodon idella*; *Cyprinus carpio*; culture performance; swine-fish integration.

1. INTRODUCTION

An integration of agriculture and aquaculture are mostly practiced at subsistence level in African countries such as Nigeria, Benin, Madagascar, Zambia, Cameroon and Malawi (Gabriel et al. 2007). In Asia, integrated agriculture and aquaculture dates back to more than 1500 years in India (Coche 1967) and more than 2400 years in China (Willman et al. 1998). While a wide range of integrated agriculture and aquaculture systems are practiced in Bangladesh, Indonesia, Malaysia, Thailand and Vietnam integrated fish farming with duck, chickens and swine is adopted in India and China (Majhi 2016). The author reported that such practices will minimize waste from various subsystems on the farm to increase yields with low inputs. Similarly, Zira et al. (2015) reported that wastes or by-products from swine farming are used as inputs in aquaculture to improve the productivity at lower cost. Integrated livestock fish systems were reported to have practiced since the Ming dynasty (14-17th century) to alleviate the pressure of high population densities and limited resources in China (Mani 2015). Henriksson et al. (2015) claims extension of integration practices in China as a result of their contribution to world's total aquaculture production of more than 60%. Fish farming is a lucrative business for the farmers in southern Bhutan. There are more than 500 fish farmers in Bhutan, and many of them practices fish farming along with other livestock such as pig, poultry and duck. Integration of fish farming with other livestock is practiced in some areas of Bhutan but it is not very popular at the moment, which might be due to lack of knowledge on the technology. Thus, this on-farm experiment was carried out to assess effect of swine fish farming integration to culture performance of Cyprinus *carpio (CC)* and *Ctenopharyngodon idella (CI)*.

2. METHODS AND MATERIALS

2.1 Study Site

The on-farm experiment of integrated swine fish culture was conducted at NR&DCA, Gelephu located at 26°51.790' N and 090°31.961' E at an elevation of 252 masl. The area falls under sub-tropical climatic condition ranging from warm and dry winter, wet and hot summer with mean rainfall ranging between 1500- to 500 mm per annum. The temperature ranges from 16-30°C.

The experiment was conducted for a duration of nine months starting from 30th September 2018 to 30th June 2019.

2.2 Fish species selection and stocking of

Two fish species namely *Cyprinus carpio* and *Ctenopharyngodon idella* were selected for the experiment based on the preference of fish farmers attributed to fast growth rate and high FCR. In total, 2160 numbers of fishes were stocked in two ponds of 270 m^2 in area each. The first pond integrated with swine is allotted as treatment 1 (T1) and second pond was allotted as treatment 2 (T2). Both ponds were stocked with 50% *Cyprinus carpio* and 50 % *Ctenopharyngodon idella* @ 4 fishes/m^2 area. During initially stocking, the mean weight recorded was 6.81 g and 3.86 g for *Cyprinus carpio and Ctenopharyngodon Idella*, respectively.

2.5 Fish feeding

Research ponds were fed with crude feed formulated from rice bran (RB) and mustard oil cake (MoC) in 2:3 ratios (Thinleyet al. 2018). Feeding rate of 3% body weight per day was adopted for this research (Jenaet al. 2001). The total biomass increment of the research ponds was estimated every bi-monthly based on sampling data (Thinley, Drukpola, & Dorji, 2018). Fishes during the experiment were fed thrice a day i.e once in morning at 8 AM, once in afternoon at 12:00 PM and then once in evening at 4 PM.

2.6 Swine feeding

During the experiment, the pigs were fed adequately with crude feed twice a day i.e. once in morning at 8.00 am and once in evening at 4.00 pm) following the recommeded feeding rate for swine (FAO 2009) during entire research period.

2.3 Data collection and analysis

Data for culture performance of *Cyprinus carpio* and *Ctenopharyngodon Idella was* recorded bi-monthly through random sampling. Forty numbers of each fish species were sampled every fortnightly and their body weight and body length were measured using digital weighing balance and length measuring board, respectively. The sampling process accounted animal welfare through application of standard operating procedure (SOP) of NR&DCA to record culture performance fortnightly. Mortality of fishes was also recorded during the research period to derive survival inferences.

The performance data collected for the study were administered independent t-test using SPSS version 23.0 and other culture performance parameters such as mean gain in length and weight, Specific Growth Rate (SGR (% per day)), survival rate (%), feed conversion ratio (FCR) and production were calculated using following formulae:

Equation 1: ***Mean gain in length (cm)***

= Mean final length (cm) – Mean initial length (cm)

Equation 2: ***Mean gain in weight (g)***

= Mean final weight (g) – Mean initial weight (g)

Equation 3: ***Specific growth rate*** *(SGR) (% per day)*

= *((logW2 –logW1)/ T)) X 100*

Where, W2 = mean final weight (g), W1 = mean initial weight (g), T is culture period (days)

Equation 4: ***Survival rate (%)***

= (No. of fishes harvested/ No. of fishes stocked) x 100

Equation 5: Feed Conversion Ratio (FCR)

= ((Total feed consumed (Kg)/ Total weight gained (Kg)) X 100

Equation 6: Production (kg/ha/9 months)

= No. of fish harvested X average weight at harvest (Kg)

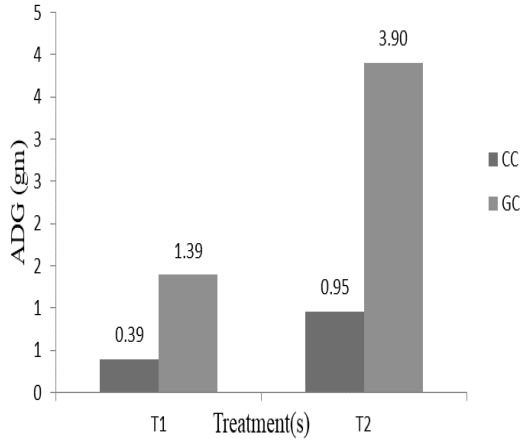

Figure 1: ADG of *C. carpio* and *C. idella* across different treatments

3.RESULTS AND DISCUSSION

3.1 Mean body weight and length of fish

The final body length and weight of the experiment fish species are illustrated in Figure 2 and 3. The mean final body weight recorded for *Cyprinus carpio and Ctenopharyngodon idella* cultured under fish swine farming integration was 93.85 ± 6.24 g and 129.75 ± 18.85 g respectively. Whereas, the mean final body length recorded was 18.55 ± 0.48 cm and 20.46 ± 0.78 cm for *Cyprinus carpio* and *Ctenopharyngodon idella*, respectively under similar condition. The mean final body weight recorded was 79.01 ± 4.50 g and 69.95 ± 11.79 g for *Cyprinus carpio* and *Ctenopharyngodon idella* cultured without integration. Under same

treatment, the mean final length recorded was 17.12 ± 0.49 cm and 15.84 ± 0.83 cm for *Cyprinus carpio and Ctenopharyngodon idella* which was not statistically significant ($p > 0.05$). Similar range of growth performance of *Cyprinus carpio* and *Ctenopharyngodon idella* was reported in mid-altitude area of Punakha district in Bhutan (Thinley 2018). However, this result contradicts with the findings of Molnar et al. (2010) who reported relatively higher mean growth indices which could have resulted due to incorporation of fodder additives.

A significant difference ($p<.05$) was observed in the overall mean final body weight of fish in T_1 and T2. The overall mean of final body weight recorded was 111.80 ± 10.07 g with length reaching about 19.51 ± 0.47 cm); whereas, in $T_{2\ the}$ overall mean of final body weight of fish observed was 74.48 ± 6.29 g with length reaching about 16.48 ± 0.48 cm (Figure 1). T-test results depicted higher growth rate in integrated pond which is an indicative of positive effect of integration having improved natural productivity sustaining pond ecosystem.

3.2 Specific growth rate

The percent SGR recorded for *Cyprinus carpio* was 0.42 and 0.39 in T_1 and in T_2, respectively. Whereas, the percent SGR recorded for *Ctenopharyngodon idella* was 0.57 and 0.47 in T_1 and T_2, respectively. Therefore, it is clear that fishes cultured with swine integration exhibits high SGR (% per day) than culture without integration. The reason for high SGR in T_1 than T_2 could be due to optimum natural productivity from day to day organic manure contributed directly from sty into T_1 fish pond.

3.3 Feed Conversion Ratio (FCR)

Concurrent with growth performance, feed conversion ratio of locally formulated feed was evaluated after nineth month of culture period for Cyprinus carpio and Ctenopharyngodon idella. The highest FCR of 9.79 and 5.68 was recorded for *Cyprinus carpio* and *Ctenopharyngodon idella* in ninth and eighth month of culture period, respectively.

The FCR value provides basic understanding on the overall efficiency of locally formulated feed and its interaction effect under integrated swine fish farming. Thus, the growth rate and FCR of two species in this study clearly indicates poor efficacy of locally formulated feed which contradicts the FCR value of 1.59 reported for local feed in Pakistan (Soom et al 2009).

3.4 Survival rate (%)

The overall survival rate recorded during the entire culture period was 74.07% and 69.26% for T_1 and T_2 respectively (Table 4). This finding clearly revealed that fishes cultured with swine recorded higher survival rate which could be attributed to favorable natural productivity supplements derived from exogenous feeding.

Molnar et al. (2010) reported a high survival rates during their experiment on influence of fodder additives on the growth indices and survival rate of *Cyprinus carpio* and *Ctenopharyngodon idella*.

3.5 Fish production

At the end of empirical investigation of swine fish integration farming, net production from T_1 and T_2 were 85.21 kg and 56.06 kg respectively. The production per unit area recorded was 0.32 and 0.21 kg fish, with total production estimation of approximately 3155.79 and 2076.42 kg/ha from T1 and T2, respectively. This finding indicates that fish farmers can derive substantially more fish products when integrated with swine that manures fish pond for natural productivity on daily basis.

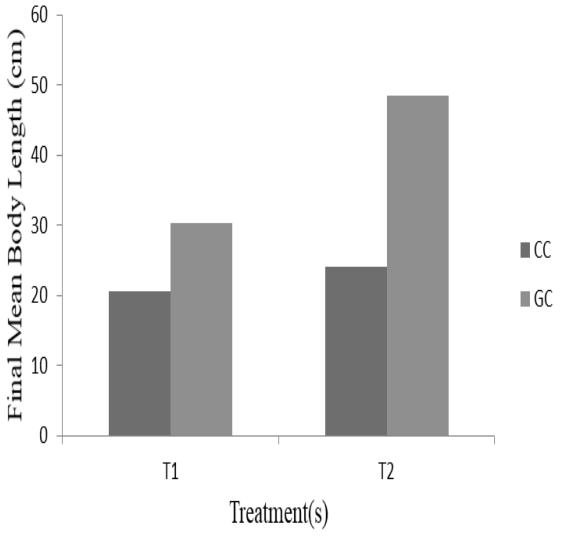

Figure 2: Final body length of two fish species

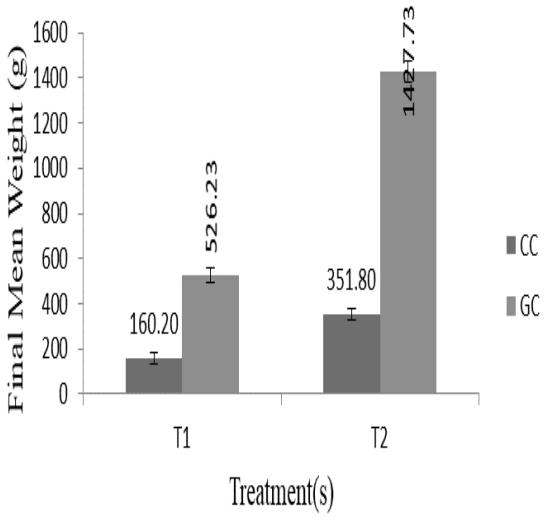

Figure 3: Final mean body weight of fish species

4. CONCLUSION

The production efficiency of cultured *C. carpio* and *C. idella* was found better in swine fish integration system as compared to conventional fish farming. Thus, it concludes that swine-fish integration can be promoted for higher fish production and maximization of resources use in the subtropical region of Bhutan.

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