International Journal of Fisheries and Aquatic Studies 2020; 8(4): 31-38


**E-ISSN: 2347-5129**
**P-ISSN: 2394-0506**
(ICV-Poland) Impact Value: 5.62
(GIF) Impact Factor: 0.549
IJFAS 2020; 8(4): 31-38

www.fisheriesjournal.com
Received: 13-05-2020
Accepted: 15-06-2020

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# Effect of stocking density on nursery rearing of common carp (*Cyprinus carpio* var *spicularis*) spawn in hapa nursery

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## Abstract
The research work was conducted to investigate the effect of stocking density on nursery rearing of Common carp (*Cyprinus carpio var spicularis*) spawn reared in hapa The experiment was carried out with three treatments group each having three replicates at Puthia fish seed production farm, Rajshahi. The Common carp spawn were collected from the same hatchery. Three different treatment with the stocking density was maintained at 400/m$^3$ ($T_1$, SD4), 600/m$^3$ ($T_2$, SD6) and 800/m$^3$ ($T_3$, SD8). Spawn were fed diet blend boiled egg yolk for 1-4 days and semi-solid wheat bran (50%) and mustard oil cake (50%) were fed remaining the study period. The physico-chemical characteristics such temperature (°C), transparency (cm), dissolved oxygen (mg/l) and pH of the pond water were monitored around the study period. All the tested water quality parameter were in acceptable limit for fry rearing. Growth performance, production of Common carp fingerling and benefit cost analysis (BCR) were studied. The weight gain and specific growth rate (SGR%, bwd/day) were significantly higher ($P$<0.05) in SD4 fish groups than SD6 and SD8 groups. The mean value of weight gain (g) was 17.955±0.17$^a$g (SD4), 15.995±0.20$^b$g (SD6) and 14.825±0.15$^c$g (SD8). The survivability at the end of the rearing of fingerling was significantly higher in SD4 (56.47±6.94$^a$ %) group than SD6 (50.80±2.40$^{ab}$ %) and SD8 (42.99±1.37$^b$ %) groups. However, the total yield of Common carp fingerling was higher in SD8 group than other groups. Yet, the BCR was significantly ($P$<0.05) higher in SD4 (1.97± 0.00$^a$) group than SD6 (1.81± 0.00$^b$) and SD8 (1.72± 0.01$^c$) groups. Stocking density of 400 spawn m$^3$ exhibited significantly higher profit of Common carp in hapa net in pond among the treatment.

**Keywords:** *Cyprinus carpio*, stocking density, production, hapa

## Introduction
Bangladesh is fortunate enough having an extensive and huge water resource scattered all over the country in the form of small ponds, beels, lakes canals small and large rivers, and estuaries covering an area of about 3.34 million ha [1]. Fisheries sector is contributing 2.01% of the total export earnings and 3.61% to the national GDP and 24.41% to the agricultural GDP [2]. Aquaculture production in cages and hapa became a popular among the pondless and landless farmers who can involve in aquaculture through the aquaculture practice. Cage or hapa culture is an aquaculture production system where fish are reared in nets. Selection of fish species, technique and fish production items plays an important role for any cage or hapa aquaculture practice. Common carp is one of the most significant fish species for aquaculture all over the world [3] and represent the species of choice due to its high growth rate, ease in reproduction, tolerance to environmental stress and its market demand. The Common carp (*Cyprinus carpio*, or carp) is a large benthivorous fish from Eurasia that has been widely introduced to other regions over the past century and is considered to be one of the world's most invasive organisms [4].
Bangladesh has 1.29 million ponds covering an area of about 0.14 million hectares of land area, together with a large area of haors, baors, beels, lakes and natural depressions, which are most potential for fish farming [5]. Availability of carp fry is the most important factor in determining the success of closed water aquaculture. From the beginning the rivers were the major source of carp seed production in Bangladesh. Millions of eggs and spawns were collected from the rivers during monsoon (May-August). Stocking density is an important parameter in fish culture operations, since it has direct effects on the growth and survival and

hence on production [6]. It is an established fact that the growth rate progressively increase as the stocking densities decreases and vice-versa. This was because of relatively less number of fish in a pond of similar size could get more space food and dissolved oxygen at the same time. The growth of fishes is dependent on population density [6].
Stocking density of different fish species in a poly culture system also plays a vital role on overall production of fish. Higher density of a species may affect the growth of another species. Similarly lower density of a species may reduce the overall production. Among the fish species that make up the backbone of the carp farming system in Bangladesh is Common carp. There should be a compatibility of species with diversified feeding habits that includes the whole range from omnivorous to macro-vegetation feeding fish species. Development of suitable techniques of nursing and rearing of larvae is very important to ensure reliable and regular supply of fish fingerlings. Successful controlled method of fry nursing depends on a proper knowledge of nutritional and environmental requirement of the larvae in the aquatic ecosystem [7]. Survival and growth of fish fry/fingerlings depend mostly on maintaining the proper stocking density to obtain maximum economic returns. Cage production is possible in ponds, lakes, reservoirs, strip pits, rivers and streams.
Inadequate seed production, season and use of open water resource, farmers are now forced to procure spawn (0.05 - 1 g) and nurse to juvenile sizes (25 - 40 g) in nylon hapa. Nursing fry in nylon hapas is one of the best options, especially in Lakes and are the most favourable because they are relatively simple to sew, easy to wash and replace, easily available, inexpensive, and enables closer monitoring and grading results in uniform size harvest and better survival [8] [9]. Moreover, fingerlings subjected to pregrow-out nursery systems in hapas can easily adapt to the Lake environment and show better performance in growth and survival than those stocked directly from ponds into the grow-out cages [10]. Nursing fry in hapas is nevertheless subjected to the effects of stocking densities and ecological problems inherent in the system. The effect of stocking density on growth and fingerling production in Nile tilapia, has been studied by several authors [11 12] with varied results.
In many countries cages aquaculture has been developed in different way with high stocking density, use of floating feed, feeding methods and selection of species. A number of research publications are available on the effect of stocking density on growth and survival rate of different fish species reported Common carp in floating cage [13], *Pangasius pangasius* in net cages [14] and on growth and production of Common carps and some on the effects of stocking density [15, 16] on survival and growth of fry and fingerlings which varied from one experiment to another. Also, effects of stocking density on growth, survival and production of mirror carp (*Cyprinus carpio* var. specularis) spawn in nursery pond have been studied [17]. Research on hapa nursery and stocking have been done on Nile tilapia (*Oreochromis niloticus*) fingerlings production [18]. To use of open water body and year round fry production, it is necessary to establish hapa nursery at appropriate stocking densities for survivability, growth and production of fingerlings. No work has yet been undertaken on stocking density of Common carp for rearing in hapa nursery. Considering the facts, the present study was performed to determine a suitable stocking density of Common carp spawn rearing in hapa.

**Materials and Methods**
The experiment was carried out in an outdoor hapa at Puthia Fish Seed Production Farm, Rajshahi, Department of Fisheries, Government of Bangladesh. A location map of the experiment site is shown in Fig 1. The experiment was performed with three different stocking density of Common carp spawn three replications.

**Design of the experiment**
Evaluations of spawn to fingerling production of Common carp in hapas fixed in a pond with three different treatments viz $T_1$, $T_2$ and $T_3$. The treatments with the different stocking density was maintained at 400/m3 (T1, SD4), 600/m3 (T2, SD6) and 800/m3 (T3, SD8) (Table 1).

**Pond preparation for fixing the hapa**
Necessary steps were followed by the farmer of the selected nursery pond to repair dyke and bottom of the study pond. All the aquatic weeds were removed from the nursery pond. These were picked up manually be hand picking, uprooting and cutting. Rotenone was used to remove predatory and unwanted fish species from the pond. After 7 days lime was treated at the rate of 247kg/ha in the experimental pond. Fertilization was done in the study pond during nursery pond preparation. The water was introduced by the pump machine. During the introduction of water in, fine mesh (2 mm) nylon net hapa was used in the mouth of the pumped water to prevent predatory fish egg, spawns, fry and adult or larvae of aquatic harmful insects to enter the nursery pond. After six days, large size insects, mainly “hash puka” *(Notonecta sp.)* were eradicated by applying sumithion (10 ml/deci) and the pond was repeatedly netted for eradication of unharmed aquatic insects and gas from the bottom the pond.

**Preparation of hapa**
The hapa used for fry rearing were rectangular in shape and 3.04 m x 1.37m x 0.91m (3.80$m^3$) in size. For construction of hapa bamboo, rope, small meshes seine net and metal ring were used. The hapas were placed about 2.13m distance from the dyke (Plate 1). The average depth was around 1.82m in which the hapas were placed. The depth inside the hapa was 0 .6m.

**Collection and stocking of fry**
Common carp (*Cyprinus carpio* var spicularis) spawn (Renu) was collected from Parthia Fish Seed Production Farm, Puthia Upzila, Rajshahi, Department of Fisheries, Bangladesh. Before releasing the fry stocking density were recorded of the experimental pond. Stocking density of the experimental fish were 400/$m^3$, 600/$m^3$ and 800/$m^3$ in the cage. The spawn was released in the rearing hapas manually by using beaker (Plate 2). The hapas were monitored regularly so that the condition of fry and hapas could be observed.

**Feed preparation and feeding**
A hatchery made mash feed (blend boiled egg yolk) was used for this experiment. The traditionally made feed was prepared with 50% mustered oil cake and 50% wheat meal. At the rate of supplemental feed was given to fry in 2 times of fry weight for 1st 3 days, 3-5 times for 4-20 days and 6-10 times for 20-30 days in different treatments. After then 2nd 30 days fry was fed with 12% body weight and last days fry was fed with 7% body weight.

**Sampling procedure**

The fries were sampled each rearing hapa by using small plastic pot at 30 days interval to determine the change in their growth in terms of weight gain and survival rate. Sampling was done in the early morning when the fish stomach was about to be empty. Weight was recorded by using a precision electronic balance (Kd-300 kc). At least 10% of fry from each hapa were randomly sampled at monthly basis by partially lifting the hapa and removing fish with a dip net. On each sampling day, fish from hapa were weighed and measured using a weight balance. After completion of the experiment at each 30 days the number of total live fingerlings in rearing hapa was counted separately for calculation of survival rate. The purpose was to determine fish growth in weight and to adjust the ration. Fishes were handled carefully to avoid stress during sampling. After the completion of the study, the fishes were entirely harvested from the hapa.

**Water quality parameters**

Water samples were collected from sub-surface of the pond at 8.00 am and chemical parameters such as dissolve oxygen were analyzed by using Hack kit box (HACK Kit, FF-2, USA). Water temperature, transparency, pH etc. were recorded by using Celsius thermometer, Secchi disc and pH meter respectively.

**Growth parameters**

The following parameters were used to monitor the growth during sampling and after harvesting. The final weight was taken at the time of harvesting and was expressed as gram (g). Initial weight (g), Final weight (g), Weight gain (g), specific growth rate (SGR, % bwd–1), Survival rate and yield (kg/m3) were calculated by using the following equations (1) (2) (3) (4) (5) (6) and (7) respectively:

Initial weight (g) = Weight of fish at stock………………. (1)

Final weight (g) = Weight of fish at harvest…………..... (2)

Weight gain (g) = Mean final weight- Mean initial weight…... (3)

Weight gain= Final weight gain- Initial weight gain …….. (4)
Specific Growth Rate (SGR %,bw/d) = [ln{(final weight) – ln (initial weight)}/ culture period]
× 100 …..(5)

$$\text{Survival rate (\%)} = \frac{\text{Number of fish at harvest}}{\text{Total number of fish stocked}} \times 100 \ldots\ldots\ldots\ldots(6)$$

Total production (kg/m3): No. of fish caught × average final weight of fish………………………………………………(7)

**Economics analysis**

The total cost during the study period and the total income from fry productions were recorded. At the end of the culture period, fry were harvested. Cost-benefit analysis of different treatments was calculated on the basis of the cost of inputs and labor to be used; and the income from the sale of fishes. The following equation was used for the calculation of net return:

R= I – (Fc + Vc + Ii)

Where R refers to net return; I, total income from fish sold; Fc for Fixed costs, Vc for variable costs and Ii for interests on input costs. The prices were expressed in Bangladesh Taka (BDT). All inputs and Common carp fingerlings were correspond to wholesale market prices of the project areas. Net benefit was calculated by deducting the total cost from total income from fry price.

The benefit-cost ratio (BCR) was also calculated using following formula:

BCR = Total revenue / Total cost

**Statistical Analysis**

The final weight(g), weight gain (g), Specific growth rate (SGR, % bwd-1), survival rate(%) and yield (kg) of fry during experimental period with same feeding & fertilization in different treatments were all tested using one way analysis of variance (ANOVA). Significant results ($P$<0.05) were further tested using Duncan's New Multiple Range Test (DMRT) to identify significant differences among means. This statistical analysis was performed with the support of the computer software SPSS (Statistical package for social sciences) program.

**Results**

**Water quality parameters**

The variations in the mean values of different water quality parameters under different treatments by the total of all month are presented in Table 2. The mean values of some water quality parameters such as temperature (°C) was 26.49±0.47 in SD4 treatment group, 26.34±0.50 in SD6 fish group and 26.27±0.47 in SD8 fish group; transparency (cm) was 37.21±0.12(SD4), 37.77±0.20(SD6), 37.88±0.34(SD8) dissolved oxygen (mg/l) was 4.73±0.04(SD4), 4.54±0.07(SD6), 4.49±0.09(SD8); and pH was 7.40±0.04(SD4), 7.51±0.03(SD6), 7.46±0.04(SD8); respectively. No significant difference ($p$<0.05) was found among the treatments for the mean values of water temperature, water transparency, pH and dissolved oxygen. During the experimental observation there was no major difference found in all the water quality parameters and was in acceptable limit for fish nursery.

**Growth performance of fish**

At the end of rearing in hapa growth performance of experimented fingerling in terms of final weight, weight gain, SGR, etc. were calculated and the results are shown in Table 3. All growth parameters in terms of final weight, weight gain and SGR were significantly varied among the treatments. Significantly ($P$<0.05) higher final weight, weight gain and SGR were the highest at SD4 fish groups than SD6 and SD8 groups. The final weight (g) of Common carp were found to be ranged from 14.83±0.15g (SD8) to 17.96±0.17g (SD4). The weight gain (g) was 17.955±0.17ag (SD4), 15.995±0.20bg (SD6) and 14.825±0.15cg (SD8) (Fig 2). The maximum value was recorded with treatment SD4 whereas the minimum value was recorded with treatment SD8. Significant difference was found among the treatments. The SGR recorded with the treatment SD4, SD6 and SD8 were 6.82±0.05[a], 6.72±0.03[b] and 6.67±0.02[c] respectfully (Fig 3). The minimum value of survival rate was recorded with the treatment SD8 whereas the maximum value was recorded with the treatment SD4.

Significantly ($P$<0.05) higher survival was observed at SD4 (56.47±6.94[a]) and lowest at SD8 (42.99±1.37[b]) (Fig 4). The survivability at the end of the rearing of fingerling was significantly higher in SD4 (56.47±6.94a %) group than SD6 (50.80±2.40ab %) and SD8 (42.99±1.37b %) groups. However, the total production of Common carp fingerling was higher in SD8 group than other groups. The mean values of total production (kg/hapa) were found to be ranged from 16.10±0.46[b] to 19.10±0.12[a]. The minimum value of yield was recorded with the treatment SD4 whereas the maximum value was recorded with the treatment SD8.

**Production and economics**

Economics of Common carp fry production in hapa under different treatments are presented in Table 4. Total cost varied from 975±2.50 to 1120±4.76 Tk/hapa. Highest total cost was found with the treatment SD8 whereas lowest cost was found with the treatment SD4. Total income varied from 2842±55.00 to 3052±35.00 Tk/hapa. Highest total income was found with the treatment SD8 whereas lowest income was found with the treatment SD6. Net profit varied from 1832±58.50 to 1932±36.50 Tk/hapa. Highest net profit was found with the treatment SD8 whereas lowest net profit was found with the treatment SD6. Benefit cost ratio (BCR) varied from 1.72± 0.005 to 1.97± 0.004. Highest BCR was found with the treatment SD4 whereas lowest BCR was found with the treatment SD8. The BCR was significantly ($P<0.05$) higher in SD4 (1.97± 0.004[a]) group than SD6 (1.81± 0.003[b]) and SD8 (1.72± 0.005[c]) groups (Fig 5).

**Discussion**

**Water quality parameters**

Fish culturists are more conscious about the maintenance of optimum condition of water quality. During the study period, the water quality parameters of the studied cages did not varied significantly among the treatments, which might be due to the good management of pond for hapa rearing. Water temperature plays an important role in the physiology of fish, the relative quality of food intake and standardization of feeding levels might also be affected to a great extent with a marked effect on overall production of fish. Findings indicated that comparatively lower range of temperature 26.27±0.47 ($T_3$) to 26.49±0.47 °C ($T_1$) was found under the different treatments during the present study. Boyd (1998) reported the suitable water temperature of 25-32 °C for warm water aquaculture species [19]. Ali *et al.*, (1982) observed temperature range of 25-35.5 °C in pond water [20]. DoF (2008) recorded temperature ranges at 26-32.44 °C in pond water [21]. These finding are also similar to of the present study. Transparency is an important physical factor, which indicates the productivity of a water body. Boyd (1998) reported the secchi disc reading 30 to 45cm as suitable for fish farming [19]. In the present study, In case of water transparency secchi disc reading varied from 37.21±0.12 ($T_1$) to 37.88±0.34 cm ($T_3$), which was near the findings of Kohinoor (2000) who recorded transparency values ranging from 15 to 58 cm [22]. Wahab *et al*. (1994) found transparency depth ranging from 5-75 cm in polyculture pond [23]. The observed range of water transparency was more or less similar with the findings of Wahab *et al*. (1995) [24]. Dissolved oxygen (DO, mg/l) is another important water quality parameter responsible for normal living of aquatic organisms. The sources of dissolved oxygen in pond are the photosynthesis of phytoplankton and aquatic plants and by diffusion from the atmosphere. In the present study, the mean values of DO significantly ($p<0.05$) varied from 4.49±0.09 ($T_3$) to 4.73±0.04 mg/1 ($T_1$). Comparatively lower values of dissolved oxygen with the treatments might be associated with the high stocking densities of the fish [19] which is similar to the present study. Lower range of DO obtained during the present study did not hamper the growth of Common carp. Wahab *et al.* (1995) recorded dissolved oxygen ranging from 2.2 to 7.1 mg/l in nine ponds at BAU campus, Mymensingh [24]. Kohinoor (2000) measured dissolved oxygen 2 to 7.4 mg/l in the research ponds of BAU campus, Mymensingh which is more or less similar to the present findings [22]. From the above findings, it is concluded that the oxygen content of the experimental ponds was within the good productive range. pH is considered as an important factor in fish culture. It indicates the acidity or alkalinity condition of a water body. It is also called the productivity index of the water body. The mean values of pH varied from 07.40 ±0.03 ($T_1$) to 7.51±0.03 ($T_2$). According to [30] pH 6.5 to 9.0 is suitable for pond fish culture and pH more than 9.5 is unsuitable because free $CO_2$ is not available in this situation. At pH 11 fish dies. pH less than 6.5 reduces fish growth, physiological activities and tolerance to toxic substances. The optimum pH range for carp poly culture in pond is 6.5-9.0 [23, 25]. Which are more or less similar vary from the present study.

**Growth performance**

Nursing of fry in hapa cages is one of way of utilizing open water bodies. In this study, rearing of spawn in hapa nursery have been performed with traditional feed mustered oilcake (50%) and rice bran (50%) was not creat any adverse effect. Boyd (1990) suggested that feeding of Common carp with mixture of oilcake and rice bran 1:1 for better production [26]. However, stocking density affects this technique in terms of fry growth performance, survival and economic profitability. Growth in terms of weight, weight gain and SGR of fries of Common carp was significantly higher in SD4 where the stocking density was low compared to those of SD6 and SD8 although the same food was supplied in all the treatments at an equal ratio. The final weight (g) of Common carp were found 17.96±0.15[a], 16.00±0.20[b] and 14.83±0.17[c]. The second highest individual weight was obtained in case of (SD6) and the lowest individual weight was obtained in case of (SD8). The Common carp fries (weight of each fry is 0.05g) were stocked at different density in different study hapa. Treatment 1 with a stocking density of 400 fish per hapa was most favorable and found all the growth parameters like final weight, weight and SGR best. This finding was found on Nile tilapia where stocking density of 400 fish per hapa was most favorable and found all the growth parameters like final weight, (feed conversion ratio) FCR and SGR best [18]. Ahmed *et al*. (2002) found that the fingerling was more or less similar from the present study [13]. Also, size variation, percentage and survival were found to be significantly affected by stocking density [27]. In the present study, the stocking density was high because of the size of fry was very small (0.05g). It was reported that the average stocking density was about 875±507 fry/cage (1 $m^3$ cage size, about 3.4cm fry length) which is more or less similar to the present study [28]. The survival rates of three different treatments of Common carp were 56.47±6.94 (SD4), 50.80±2.40 (SD6), 42.99±1.37 (SD8) respectively after experimental period. A significantly ($p<0.05$) higher survivability observed in the treatments $T_1$. Experiments were conducted in rearing hapa to study the effect of different stock density on the fingerling production of Common carp. Haque *et al*. (1993) reported survival carp spawn in different pond were 70.07%, 71.44%, 58.32% respectively [16]. The survivality of the present study was lower than following finding because of the high stocking densities and small size fry culture. Mane (2014) was culture Common carp in small reservoir and found about 39.5% survival rate which is lower than the present study [29].

**Production and economics**

The production and economics in terms of benefit cost production (BCR) was significantly increased in fry group stocked 400/m$^3$ (SD4) than stocking group 600/m$^3$ (SD6) and 800/m$^3$ (SD8). The BCR was significantly ($P$<0.05) higher in SD4 (1.97± 0.004a) group than SD6 (1.81± 0.003b) and SD8 (1.72± 0.005c) groups. Fry production of Common carp from cage obtained a yield at harvest, standing crop biomass averaged 7.82, 12.83 and 11.58 kg/m$^2$ with 240 days from 3 similar cages with supplemented feeding [13]. However, production and profit index of Nile tilapia fry in stocking density1200/hapa was higher than lower stocking density [18]. Gupta and Haque (2011) were calculated that the fingerling production cost of Common carp was about BDT 268±129.2/cage (1m$^3$ in size) while the cost of present study was higher than the following data because of large size cage was used [28]. In the present study, although growth rate is found best in 400/m$^3$ stocking density (SD4).

**Table 1:** Design of the experiment with Common carp, *Cyprinus carpio* var *specularis*

| Treatment | $T_1$ (SD4) | $T_2$ (SD6) | $T_3$ (SD8) |
|---|---|---|---|
| Stocking density (piece/m3) | 400 | 600 | 800 |

**Table 2:** Water quality parameters under different treatments during the study period

| Treatments Parameters | SD4 | SD6 | SD8 |
|---|---|---|---|
| Water temperature (°C) | 26.49±0.47 | 26.34±0.50 | 26.27±0.47 |
| Transparency (cm) | 37.21±0.12 | 37.77±0.20 | 37.88±0.34 |
| DO (mg/l) | 4.73±0.04 | 4.54±0.07 | 4.49±0.09 |
| pH | 7.40±0.04 | 7.51±0.03 | 7.46±0.04 |

Figures in a row bearing common letter(s) do not differ significantly ($p$<0.05)

**Table 3: G**rowth parameters under different treatments after rearing

| Treatment Parameters | SD4 | SD6 | SD8 |
|---|---|---|---|
| Initial weight (g) | 0.005±0.00$^a$ | 0.005±0.00$^a$ | 0.005±0.00$^a$ |
| Final weight(g) | 17.96±0.15$^a$ | 16.00±0.20$^b$ | 14.83±0.17$^c$ |
| Weight gain (g) | 17.955±0.17$^a$ | 15.995±0.20$^b$ | 14.825±0.15$^c$ |
| SGR (%) | 6.82±0.05$^a$ | 6.72±0.03$^b$ | 6.67±0.02$^c$ |
| Survival rate (%) | 56.47±6.94$^a$ | 50.80±2.40$^{ab}$ | 42.99±1.37$^b$ |
| Total production (kg/hapa) | 16.10±0.46$^b$ | 16.23±0.56$^b$ | 19.10±0.12$^a$ |

Figures in a row bearing common letter(s) do not differ significantly *($p$<0.05)*

**Table 4:** Economics of fingerling production of common carp

| Treatments Cost items | SD4 (BDT) | SD6 (BDT) | SD8 (BDT) |
|---|---|---|---|
| Net, rope and sewing of net | 300 | 300 | 300 |
| Metal ring | 100 | 100 | 100 |
| Bamboo | 200 | 200 | 200 |
| Feed cost/hapa | 60±2.50$^c$ | 90±3.50$^b$ | 140±1.50$^a$ |
| Cost of seed | 15 | 20 | 30 |
| Labor cost | 200 | 200 | 200 |
| Others | 100 | 100 | 150 |
| Total cost | 975±12.50$^c$ (256.56/m$^3$) | 1010±15.87$^b$ (265.79/m$^3$) | 1120±14.76$^a$ (294.74/m$^3$) |
| Total income | 2898±87.50$^b$ (762.63/m$^3$) | 2842±55.00$^b$ (747.89/m$^3$) | 3052±35.00$^a$ (803.16/m$^3$) |
| Net profit | 1923±90.00$^b$ (506.05/m$^3$) | 1832±58.50$^c$ (482.11/m$^3$) | 1932±36.50$^a$ (508.42/m$^3$) |
| BCR | 1.97± 0.004$^a$ | 1.81± 0.003$^b$ | 1.72± 0.005$^c$ |

Figures in a row bearing common letter(s) do not differ significantly ($p$<0.05),

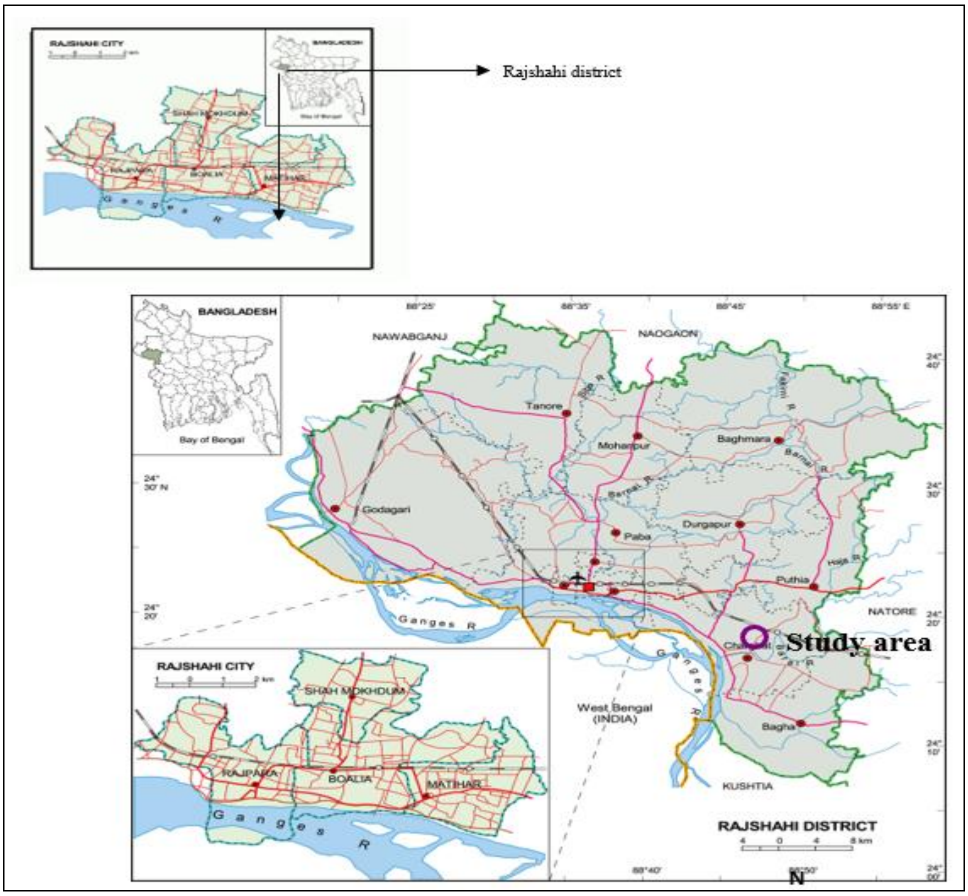


**Fig 1:** Showing the study area (O)

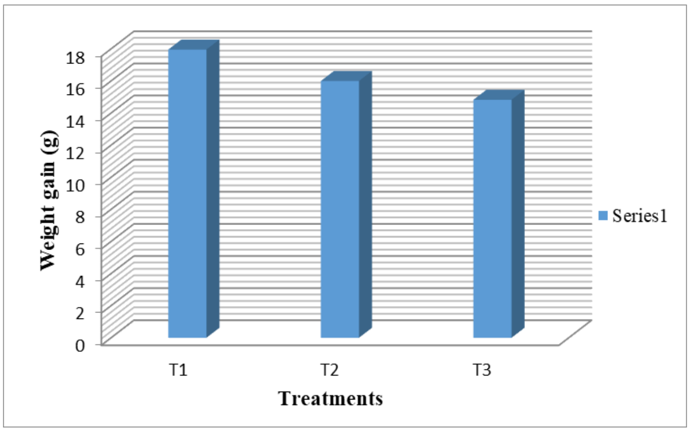


**Fig 2:** Weight gain among the treatments after rearing

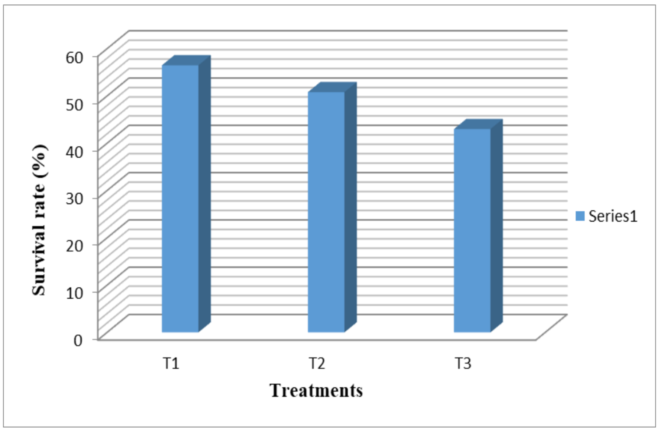


**Fig 4:** Survival rate (%) among the treatments after rearing

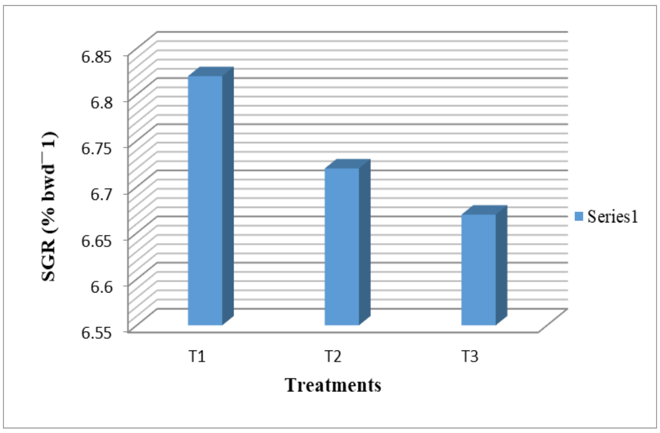


**Fig 3:** Specific growth rate (SGR, bwd$^{-1}$) among the treatments after rearing

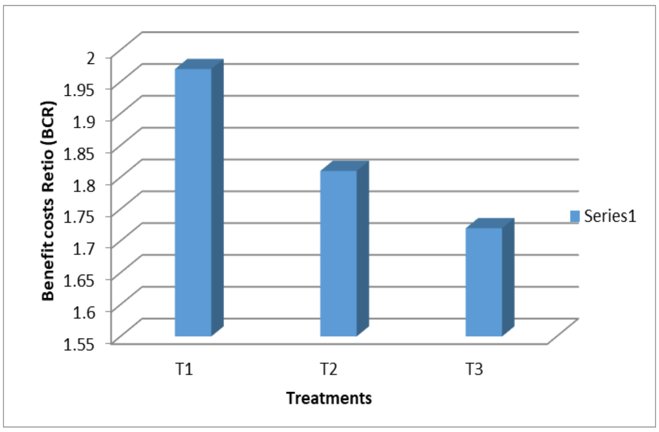


**Fig 5:** Benefit costs ratio (BCR) among the treatments after rearing

**Plate 1:** Placed of hapa in the pond

**Plate 2:** Releasing of Common carp spawn

## Conclusion
Hapa nursery is a simple tools for utilizing open water to fry production. It was evidenced from the present study that hapa can used for nursery of Common carp fry with a suitable water quality. Stocking density of 400 spawn/m3 exhibited significantly higher profit of Common carp in hapa net in pond among the treatment.

## Acknowledgements
Profound thanks and warm appreciation are to Md. Abdul Khaleq, Farm Manager, Puthia Government Fish Seed Production Farm, Department of Fisheries, Bangladesh for his help and suggestion for facilitate the research. We express our gratitude to Department of Fisheries, Rajshahi University, Rajshahi, Bangladesh for the facilities provided to carry out this research work.

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