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Utilization of farmer operated water harvesting ponds *"Jalkund"* for Nursing of carp fry in Meghalaya

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ABSTRACT

A low-cost rainwater harvesting structure called Jalkund of varying capacity (6000-30,000 l of water) has been developed for the hilltops at the ICAR Research Complex for NEH Region, Umiam, Meghalaya. During winter months when there is no rainfall, water conserved in these poly-lined ponds (Jalkund) act as a lifeline for the seasonal crops. The present study was conducted at selected farmer's field of Nongthymmai village of Ri-bhoi district, Meghalaya with an aim to exploit the Jalkund for nursing of carp fry as quality fish seeds of appropriate size are not readily available in the area for aquaculture. The fry of Amur and local common carp, *Cyprinus carpio*, *Cirrihinus mrigala* and *Labeo gonius* were stocked at different stocking densities to assess the growth and survival of fry. The Amur common carp demonstrated better growth as compared to local common carp in a rearing period of 10 weeks during May-July' 2015. The maximum growth of Amur common carp was observed to be 7.84±0.1 g in terms of weight and 7.67±0.15 cm in terms of length when stocked at 3 Lakh/ha with a survival of 76%. While the Cirrihinus mrigala had recorded 5.84±0.37 g in weight and 9.51±0.36 cm in length when stocked at 1 Lakh/ha with 67% survival in a rearing period of 15 weeks during colder months (August to December 2015). During the same period Labeo gonius -an important minor carp, recorded a growth of 5.56±0.3 g in terms of weight and 6.81±0.16 cm in length when stocked at 3 lakh/ha with a survival rate of 62%. The SGR was found to be highest at the lowest level of stocking density. The paper highlights the importance of Jalkund in fish seed rearing for higher growth and survival without affecting its primary role of life saving irrigation in agricultural crops.

1. Introduction

The phenomenon of climate change and its related events has been constantly affecting the activities for agricultural production. Improvement of rural people livelihood via adoption of climate resilient activities is urgently required at this present scenario. Water plays a key element for successful agricultural production. Thus the accessibility of water assets has critical effect on the agrarian generation. Although, northeastern part of India received abundant rainfall, due to lack of suitable water conservation measures like water harvesting structures made the region water scarcity especially during the post monsoon period (Saha *et al.,* 2007). The changing rainfall pattern with erratic distribution exaggerated the issues of water availability for agricultural activities. Along these lines the conservation of rain water through intervention of water conservation structures becomes highly essential and economical one. Moreover, over the hilly terrain areas rainwater harvesting bears great opportunities in providing water requirements for several end users. In this context, Jalkund, a water catch pit (micro rain water harvesting structure) can be considered a suitable technology for ensuring water necessities during water scarcity period and could intervened as climate resilient activity thereby improving the livelihood of small and marginal farmers.

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In the Northeast India, almost 95% of the population consume fish and therefore Aquaculture plays an important role in terms of nutritional and livelihood security. During the dry season, the activities of aquaculture faced a serious problem especially for nursing of small fingerlings. However, through the intervention of *Jalkund*, water can be stored in the area where nursing of small fingerlings can be successfully carried out. Therefore the present study was conducted to utilize the water of existing water harvesting tank (*Jalkund*) for raising fry up to the stage of fingerling. Therefore, a study was conducted to utilize the water of existing water harvesting tank (*Jalkund*) for raising fry to the stage of "fingerling" – the much needed basic input for fish farming, besides utilizing of the same water for life saving irrigation in agricultural crops.

2. Materials and Methods

The present study was conducted at selected farmer's field of Nongthymmai village of Ri-bhoi district, Meghalaya. The total annual rainfall received during 2016 was 2204.4 mm in which about 1495 mm was received during the monsoon months. The mean monthly maximum and minimum temperature was 30.2°C and 19.8°C, respectively. The mean monthly relative humidity ranged from 42 to 89.3 %. Water scarcity during post monsoon period is very prominent in the hilly terrain region. Water harvesting structure locally known as 'Jalkund' is generally constructed to collect and store water for life saving irrigation in agricultural crops. The stored water in the *Jalkund* was utilized for nursing of carp fry. The *Jalkund* are constructed as per the water requirement for different purposes. In this study, the capacity of water storage in jalkund range from 6,000 to 30,000 l by considering the seepage loss of water. The dimensions of the jalkund were 5x4x1.1 m^3, 6x5x1.1m^3 and 7x5x1.1 m^3.

Excavation

Excavation of kund was made before the onset of monsoon. During the excavation process, proper care was taken while maintaining the side slope of the kund wall for better stability and grasps the lining material.

Plastering

Plastering of bed and kund walls was done by using slurry of clay and cow dung prepared in the ratio of 5:1. This process is generally done for improving the smoothness of the bottom surface and sides of the kund as well as to reduce the damage in lining material.

Cushioning

Locally available materials like paddy straw or thatch grass were used for cushioning purpose. Cushioning was done by placing 10-15 cm thick of paddy straw or thatch along the sides and bottom of the jalkund for better smoothening of the surface.

Lining

Lining of Jalkund was done by using LDPE agri-film (250 micron thickness) or silpaulin. For better stability and firmness of the sheet, trench size of 25 x 25 cm was prepared around the *Jalkund* to cover the ends of lining materials. A soil layer of 10 cm thickness was placed at the bottom to ensure fish farming activity. Liming and manuring was carried following standard procedures of rearing tank (Annon.2006).

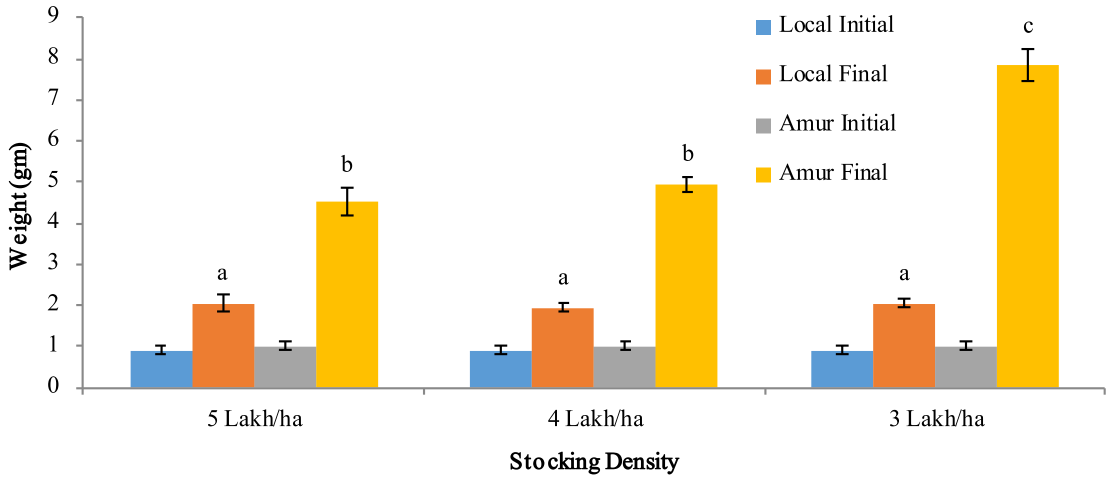

Figure 1. Increase in weight of Amur common carp and Local common carp fry at different stocking densities ($p<0.05$)

Rearing of fry

The fry of Amur common carp and local common carp (*Cyprinus carpio*) at a ratio of 1:1 were reared for a period of 10 weeks during May-July in three different stocking densities *i.e.* 5 lakh/ha, 4 lakh/ha and 3 lakh/ha. Three replications were maintained for each of the stocking density. And the *Cirrihinus mrigala* (Mrigal) and *Labeo gonius* (Gonius) fry were reared for a period of 15 weeks during colder months (August to December) at stocking densities of 1 lakh/ha and 2 lakh/ha for Mrigal and 3 lakh/ha for Gonius to determine the growth and survival from fry to fingerlings stage. The reared fish fry were fed *ad libitum* twice a day with only locally available rice polish. The observational data on fry growth and water parameters such as DO, pH, water temperature, TDS and conductivity were recorded periodically. During the off season, the *Jalkunds* were covered with

Statistical Analysis

The data obtained are subjected to analyse one way analysis by using SPSS20 to determine the mean difference.

3. Results

The present study showed that the growth of Amur common carp fry is better than the local common carp fry when stocked at different stocking densities. The maximum growth of Amur common carp was observed to be 7.84±0.1 gm in terms of weight and 7.67±0.15 cm in terms of length when stocked at 3 Lakh/ha with a survival of 78%. Similarly, local common carp also showed maximum growth and survival at this stocking density with 2.05± 0.4 gm, 5.36±0.15 cm and the maximum survival at 80%. However, the growth and survival of both the variety decreases with increasing stocking density, which may be owing to the increase in competition for food and space (Figure 1 and 2). In a similar study the Amur common carp performed better than the Local common carp when reared in earthen ponds under mid hill condition (Das, 2017). The water quality parameters also varied during the culture period *i.e.* from May to July 2015. The variation in the basic water parameters like Dissolved Oxygen (DO), pH, Conductivity, Total Dissolved Solids (TDS) and Average Temperature is represented in the figure 3 given below.

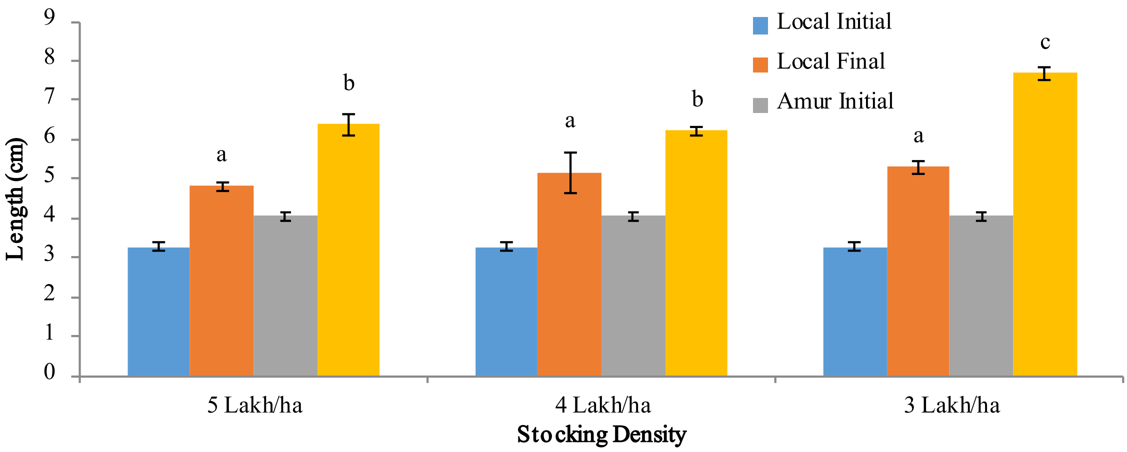

Figure 2. Increase in Length of Amur common carp and Local common carp fry at different stocking densities (p<0.05)

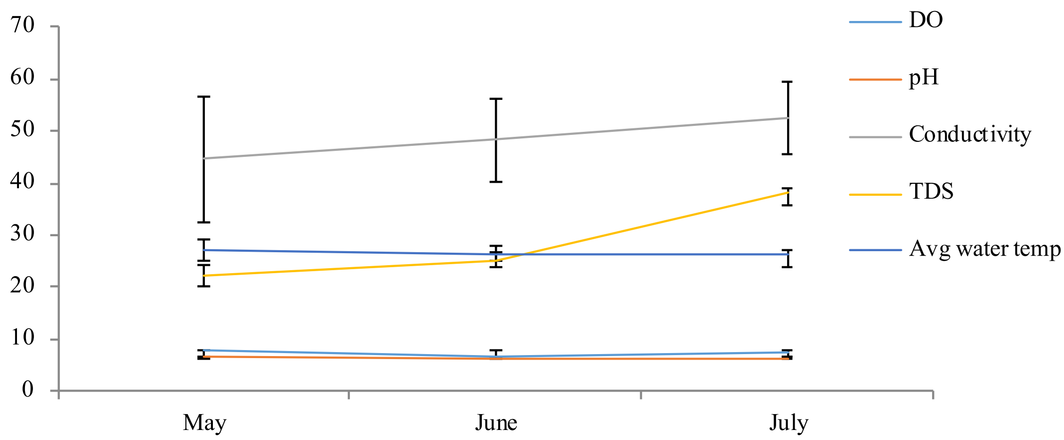

Figure 3. Variation in the water quality parameters during the culture period from May to June

In another experiment during the colder months, the fry of Mrigal and Gonius were reared to the stage of fingerling. The growth of Mrigal was observed to be maximum with 5.84±0.37gm in terms of weight and 9.51±0.36 cm in length when stocked at 1 Lakh/ha with 67% survival whereas at a stocking density of 2 lakh/ha they grew to the size of 4.98±0.37gm in weight and 7.6±0.14 cm in length with a survival rate of 64%. Gonius recorded a growth of 5.56±0.3 gm and 6.81±0.16 cm in terms of length and weight when stocked at 3 lakh/ha with a survival rate of 62%. The water quality parameters were recorded in the entire culture period and presented in the figure 6 below.

4. Discussion

The Amur common carp demonstrated better growth as compared to local common carp in a rearing period of 10 weeks during May-July. The maximum growth of Amur common carp was observed to be 7.84±0.1 gm in terms of weight and 7.67±0.15 cm in terms of length when stocked at 3 lakh/ha with a survival of 76%. While the Cirrihinus mrigala had recorded 5.84±0.37gm in weight and 9.51±0.36 cm in length when stocked at 1 lakh/ha with 67% survival in a rearing period of 15 weeks during colder months (August to December 2015). During the same period Labeo gonius -an important minor carp, recorded a growth of 5.56±0.3 gm in terms of weight and 6.81±0.16 cm in length when stocked at 3 lakh/ha with a survival rate of 62%. The SGR was found to be highest at the lowest level of stocking density. The effect of stocking density and fish species had no significant influence on the growth of fry during the initial period and is in agreement with the works of Aksungur *et al.* (2007) and Moradyan *et al.* (2012). However, significant variation on the growth of fish species was observed in the final stage. The growth and developmental process of fish is controlled by several factors such fish species, feed quality, water quality, stocking density, competitiveness among the fish species when reared together, *etc.* Among these factors, the rate of fish stocking holds a significant effect in determining the growth and development of fish. This may be attributed to the difference in the growth among the fry of different fish species in the present study. This result is in accordance with the studies of M'balaka *et al.* (2012) and Garr *et al.* (2011). A disparity in the specific growth rate (SGR) of amur carp and local carp fry was also also evident from this study. The 10 weeks study of amur carp and local common carp stocking at three level of density found that highest SGR was noticed at the lowest stocking density (3 Lakh/ha). Similarly, in 75 weeks study also highest SGR was recorded in lowest stocing density (1 lakh/ha). However, the value was not significantly different between the species. While, in case of 10 weeks study, species wise, amur carp fry outperformed local carp in all the three level of density stocking and this might be due to higher feed utilization of the amur carp as compared to local carp. In this regard, Verma and Mandal (2018) also reported that amur carp had better SGR than catla, rohu, mrigal, silver carp and silver barb. While, in case of 4 months study of mrigal and gonius the value of SGR was almost similar. The survival percentage data revealed that fish fry rearing in the lesser stocking rate has achieved better survival percentage as compared to higher stocking density. This indicate that survival percentage is inversely correlated with the stocking density of the fish (Rahman *et al.,* 2016; Sorphea *et al.,* 2010). The present study also observed that relatively the growth of Amur common carp was better than local common carp fry and similar result was reported by Basavaraju *et al.* (2012) and Das (2017).

The water quality governed by various physico-chemical and biological parameters has significant influence on the fish cultural operation (Landau, 1992). Water temperature, one of the important abiotic factors, controls various parameters in the life span of teleost fish (Das and Majhi, 2014). The monthly average water temperature in the Jalkund varied from 260 C to 270 C with a minimum temperature of 24 0C during May to July while the monthly average water temperature ranged between 190C to 26.90C with a minimum of 17.70C during August to December. The low water temperature during the months of August to December may be one of the reasons for longer rearing period. The favourable water temperature for growth of carp fish generally range between the temperatures of 25-320C.

Other water quality parameters analyzed during the experimental period were found to be within the permissible limit for fish cultivation. Although, there was variation in the water quality during the experimental period, the limits were sustained within permissible limit and thus did not influence on the growth of fry except the water temperature.

The introduction of fish seed raising activities in the existing Jalkunds shall not only make the quality fish seeds available in the village but also help the farmers in earning additional incomes from the sale of fish seeds twice in a year.

5. Acknowledgements

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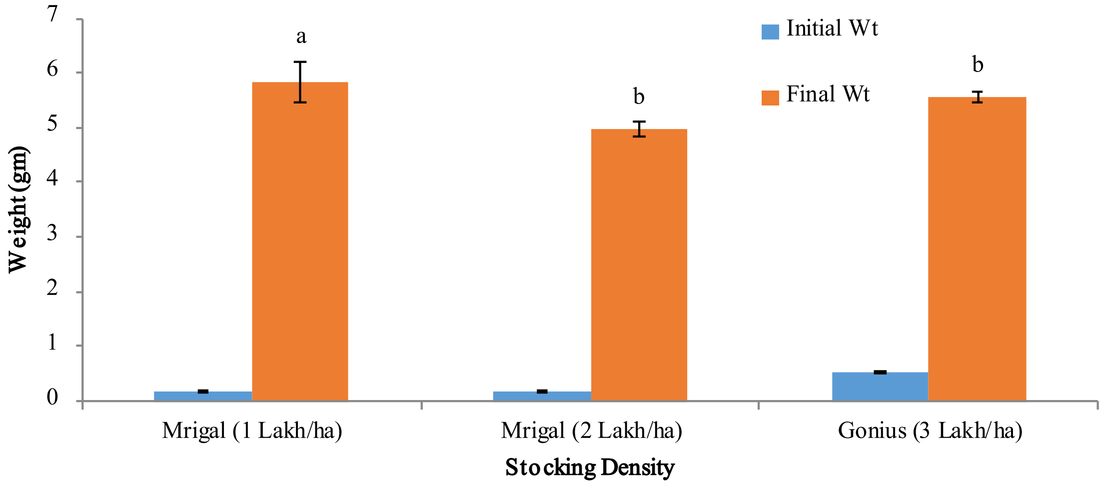

Figure 4. Increase in Weight of Mrigal and Gonius fry at different stocking densities ($p<0.05$)

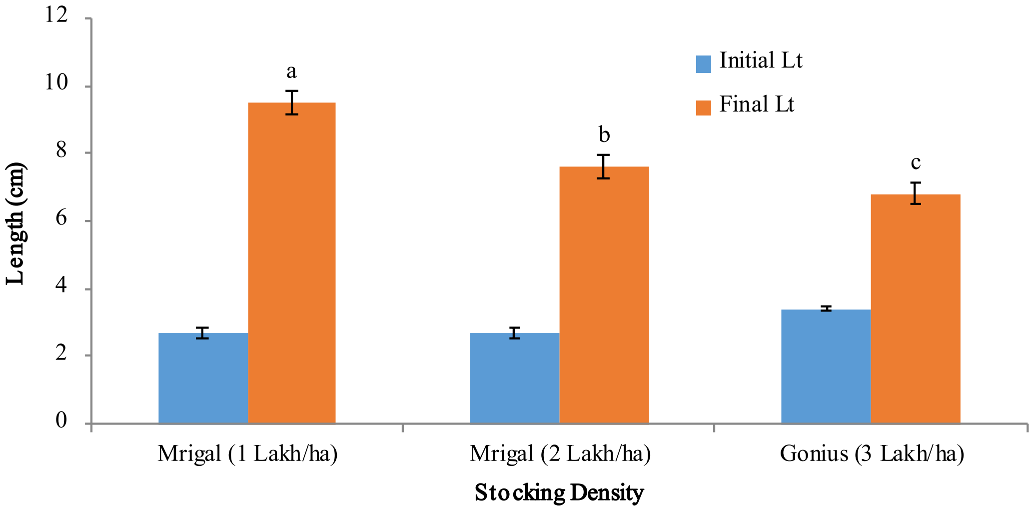

Figure 5. Increase in Length of Mrigal and Gonius fry at different stocking densities ($p<0.05$)

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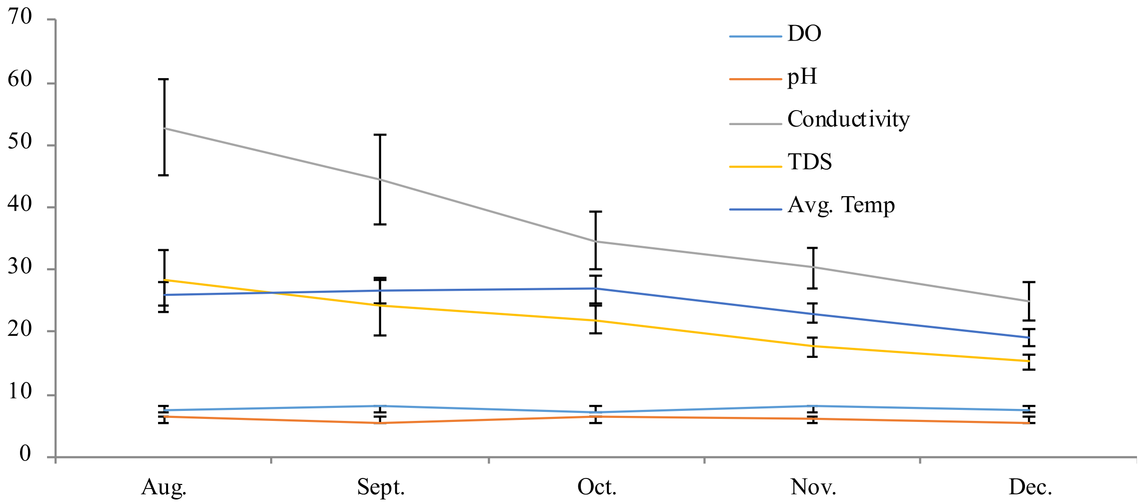

Figure 6. Variation in the water quality parameters during the culture period from August to December