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Under-utilized water bodies for poly culture of fish in high altitudes for livelihood of tribal farmers

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Abstract
Fish poly-culture of the Indian major carps, Catla catla (catla), Labeo rohita (rohu) and Cirrhinus mrigala (mrigal) together with the Chinese grass carp (Ctenopharyngodon idella) in stagnant water bodies without aeration was carried in tribal areas of Buttaigudem Mandal, West Godavari District, Andhra Pradesh. Rainwater was harvested in small size water bodies, which were under-utilized and are being used for the storage of water for agriculture during summer season. These underutilized water bodies were converted into fish production for their livelihood of tribal farmers through income generation and nutritional security. Under tribal sub plan activities by Krishi Vigyan Kendra, Venkataramannagudem four such small water bodies in Pandugudem and Bandarlagudem villages of Buttaigudem Mandal were selected for implementation of the programme. Better management practices were followed and aimed at high yields of table size fish during this short duration of water storage. Manures like cow dung, goat dung, poultry excreta, etc., were used to produce the plankton in the ponds. The fishes were fed with the commercial pelleted protein rich feed having 24 % protein. Maximum growth and size was achieved in the grass carp followed by catla, rohu and mrigal. The production was varied from 2162 kg /acre to 2883 kg/acre and this rose to an average of 2412 kg/acre. The average gross income generated was recorded as about Rs. 2,41.200/- (Average market price of Rs. 100/- per Kg.). The duration of the culture was 10 months. This demonstration shows that the raising of fish in semi-intensive culture for growing of fish in tribal areas for their enhanced income generation and nutritional security.

Keywords: Under-utilized water bodies, poly culture, tribal farmers

Introduction
Fisheries are one of the food producing enterprises contributing for the betterment of mankind in the world. The fisheries resources are of utmost importance for food security. Fish is considered as the cheapest and most easily digestible animal protein obtained from natural tanks/enclosures/aquaculture systems. The population increase in India has risen tremendously with its corresponding increase in demand for food. Thus, there is a need for suitable sustainable culture methods to meet the increasing demand and also to maximize the utilization of available limited resources without much wastage. Poly culture of fishes is ideal solution for utilization of resources available in the pond ecosystem. Water quality for aquaculture refers to the quality of water that enables for successful cultivation of desired organisms and this comprises various physico-chemical parameters of water. The water quality parameters *viz:* colour, odour, temperature, pH, DO, BOD, TDS, EC, transparency, acidity, alkalinity and hardness determines the most important limiting factor in the fish culture (Boyd, 1990; James 2000) [4]. These physicochemical values are having the standard and desired range of values and are useful for interpretation of data (Stone *et al.*, 2013) [6]. Water percolation tanks were made to utilize the water resources during the summer. Since, in this region the rainfall was high during raining season and goes waste as runoff. The water available in these water bodies are used for crop production. Cashew is the predominant crop in these areas. The rainwater harvesting and its reutilizing not only increase the productivity of agriculture and horticulture crops but also can be used for fish culture for short periods. Conservation of water and land resources gives creditable solution for alleviating and improving the livelihoods of rural poor.

Material and Methods
Ponds selection
Rainwater was harvested in small size water bodies, which were under-utilized and are being used for the storage of water for agriculture during summer season. These underutilized water bodies were converted into fish production for the livelihood of tribal farmers for income generation and nutritional security. Under Tribal Sub Plan (TSP) activities by Krishi Vigyan

Kendra, Venkataramannagudem four such small water bodies/tanks in Pandugudem (2 tanks) and Bandarlagudem (1 tank), Kamaikunta (1 tank) villages of Buttaigudem mandal, West Godavari District, Andhra Pradesh designated as P_1; P_2; P_3 and P_4 respectively were selected for implementation of the programme during the year 2016-17. The ponds were made free of weeds; sun dried for about 15 days and then lime was applied at the rate of 200 kg ha-1 for buffering capacity, eliminate pathogens and to nullify the pH alterations.

Fish stocking, feeding and harvesting

Indian major carps (IMC), *Catla catla (catla), Labeo rohita* (rohu) and *Cirrhinus mrigala* (mrigal) together with the Chinese grass carp (*Ctenopharyngodon idella)* in stagnant water bodies without aeration were stocked with the stunted fish fingerlings of 10,000 Nos per ha of area. Seed stocks of equal size, good quality and disease free with good growth rate potential were selected for stocking. Stocking was done in the early morning (before 9.30 a.m.) when the temperature of water was low. Before stocking, the fish seeds were kept in 2% NaCl solution bath for 1-2 minutes for well acclimatization to pond water. The mean initial weights of catla, grass carp, rohu and mrigal species were 25.5 ± 1.09g, 21.5 ± 1.29g, 22.5 ±1.08 g and 21.3 ±1.06 g respectively.

The fishes were fed with rice bran mixed with commercial pelleted protein rich feed having 24 % protein feed (sinking type of 2-4 mm diameter) to meet the requirements of fish. The fishes were fed based on the body weight. Harvesting of fish was done using the drag nets after 8 to 10 months of culture duration.

Monitoring of Water quality Parameters

Water samples were collected on two dates for testing the physico-chemical parameters of water like water colour, water temperature, pH, dissolved oxygen (DO), salinity, ammonia, etc. and were monitored. Water colour was observed visually. Dissolved oxygen and temperature were measured with the multi-parameter DO meter (Thermo Scientific, Singapore) and pH with pH Tester 30 (Eutech Instruments, Part of Thermofisher Scientific, Singapore), Total Dissolved Solids (TDS), Electrical Conductivity (EC), salinity were measured with TDS Tester, EC Tester, Salt Tester (Eutech Instruments, Part of Thermo fisher Scientific, Singapore). Total ammonia nitrogen (TAN), nitrite nitrogen, nitrate nitrogen, were analyzed using water testing kit (Nice Chemicals Pvt. Ltd, Cochin, India).

Results & Discussion

Composite fish culture involving surface feeder (Catla), column feeder (Grass carp and rohu), and bottom feeder (Mrigal) constituting 30, 40 and 30%, respectively were adapted. Better management practices were followed and aimed at high yields of table size fish during this short duration of water storage. Manures like cow dung, goat dung, poultry excreta, etc., were used to produce the plankton in the ponds. The natural food i.e. plankton (phyto and zoo) borne out of continuous fertilization due to poultry droppings and manuring was sufficient for the fish to feed. The KVK has trained the tribal farmers on improved method of feeding (use of feed, quality feed and timing of feeding etc.) and other practices for enhancing productivity of fish. Further, the KVK has provided the concentrate fish feed as critical input to the tribal farmers.

The colour of the pond water was observed visually. The colour of pond water of P_1, P_2 and P_4 were found to vary from brown to light red colour and of pond 3 water ranged from light green colour. The light green colour represents the presence of phytoplankton in lower quantity. Brown or light red colour depicts the soil colour, which they have pumped from outside canal/rain water. Since these water bodies are rain water harvesting tanks. The temperature of the pond water ranging from 30.5±0.68 to 36.5±0.5ºC, 31.2±0.38 to 38.3±0.85ºC, 29±0.6 to 37±0.56ºC, 32.7±0.23 to 36.3±0.58ºC in P_1, P_2, P_3 and P_4, respectively. The pH values in P_1, P_2, P_3 and P_4, were fluctuated from 7.1 ± 0.02 to 7.25±0.02, 7.12±0.02 to 7.23±0.04, 7.01±0.05 to 7.18±0.01, and 7.2 ±0.02 to 7.28±0.03 respectively. The dissolved oxygen (DO) in the pond water was ranges from 5.9±0.3 to 6.1±0.2 mg/L, 6.5±0.2 to 6.9±0.3 mg/L, 5.9±0.2 to 6.2±0.21 mg/L and 6.5±0.12 to 6.9±0.3 mg/L. The Electrical conductivity (EC) values ranged from 183±2 to 224±1 µs/cm, 213±2 to 244±2 µs/cm, 236±1 to 272±2 µs/cm, and 205 to 222±2 µs/cm. The values of the total alkalinity of pond water were ranging from 68±3 to 79±2mg/L as $CaCO_3$, 82±3 to 89±2 mg/L as $CaCO_3$, 65±3 to 78±3 mg/L as $CaCO_3$, and 72±1 to 83±2 mg/L as $CaCO_3$, in P_1, P_2, P_3 and P_4, respectively. Hardness as $CaCO_3$ values ranged from 75±1 to 82±2 mg/L as $CaCO_3$, 62±1 to 74±2 mg/L as $CaCO_3$, 80±2 to 85±1 mg/L as $CaCO_3$, 76 to 86±1 mg/L as $CaCO_3$, in P_1, P_2, P_3 and P_4, respectively. The desirable range of water quality parameters of a freshwater body of pH, 6.5-9.0; Alkalinity 50 – 150 mg/L (measured as $CaCO_3$); EC 60 – 2,000 µs/cm; hardness 50 – 150 mg/L as $CaCO_3$ (Stone *et al*., 2013) [6]. The EC values in pond range between 150 and 500 µs/cm (James, 2000) [4].

The fishes were fed with commercial pelleted protein rich feed with 24% protein. Maximum growth and size was achieved in the grass carp followed by catla, rohu and mrigal (Table 1). Since, the performance of grass carp was good mainly because of availability of grasses to fish from pond dykes and marginal weeds. But the fishes were ranging from 800 grams to 1150 grams of weight. Partial harvesting was done after 8 months and then the periodical harvesting either weekly or fortnightly was done using cast net. Based on the demand of the fish, the harvesting was done. Tribal farmers are now able to get regular fish catch from these ponds by selling 50 to 100 kgs per week @ Rs. 100/ kg and they are able to earn about Rs.5000 to 10000/- per pond. The total production was varied from 2162 kg /acre to 2883 kg/acre and this rose to an average of 2412 kg/acre. The average gross income generated was recorded as about Rs. 2,41.200/- (Average market price of Rs. 100/- per Kg.). The duration of the culture was 10 months. This demonstration proved that the raising of fish in semi-intensive culture for growing of fish in tribal areas can result in enhanced income and nutritional security. The present results were concord with the earlier findings of Das *et al.* (2014) [2] and Chakrabati *et al.* (2014) [3].

Conclusion

The present study was conducted to assess the fish production and water quality in the upland areas, of Buttaigudem Mandal, West Godavari District. The average production from these ponds was 2412 kg/acre. The underutilized water bodies/ponds can be used for cultivation of poly culture in semi-intensive culture practices will increase the income apart from the regular culture practices. Effective utilization of natural resources and conservation will increase the yield of production and income.

Table 1: Growth analysis of fish species at Pandugudem village

Species	Weight (g/fish)	Maximum weight of a single fish (g)
Grass carp	610 ± 58.5	1150
Catla	510 ± 52.6	975
Rohu	445 ± 45.7	800
Mrigal	350 ± 35.3	800

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