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# Economic feasibility of composite fish culture (CFC) in East Siang district, Arunachal Pradesh

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**Abstract**
An investigation was carried out to evaluate growth performance, yield and economic analysis of Composite Fish Culture (CFC) during 2016–2018 by conducting four multi-locational trials at farmers' field. Six species of carps *viz.* Rohu (*Labeo rohita*), Catla (*Catla catla*), Mrigala (*Cirrhinus mrigala*), Grass Carp (*Ctenopharyngodon idella*), Common carp (*Cyprinus carpio*) and Silver carp (*Hypophthalmichthys molitrix*) were stocked in a ratio 2 Catla: 2 Rohu: 1.5 Mrigal: 2 Silver carp: 1 Grass carp: 1.5 Common carp in the rate of 7000 numbers per hectare. The recommended best management practices for CFC were applied during the trial. The average productivity of the fishes from experimental locations were recorded as 19.4 q, 20.2 q and 19.9 q respectively whereas the average total cost of production per hectare was Rs. 1, 46,667. The benefit-cost ratio of 2.16 reflected the adoption of good management practices in production of fishes resulting CFC as a profitable venture.

**Keywords:** Benefit cost ratio, composite fish culture, carp, growth, yield

## Introduction
Fish farming has a great capacity of making more food available thus enhancing food security and creating more jobs for the teeming unemployed masses in the country [6].The productivity and economic feasibility in an aquaculture system plays an important role in the overall growth of the Indian economy. The pursuance of the policy initiative taken by the Government of India towards doubling the farmers' income by March 2022 necessities the study on feasibly of technology driven aquaculture activities. The hill states like Arunachal Pradesh with deep valley and high mountain peaks traversed by number of rivers and rivulets, with varies agro-climatic zones is further more challenging in undertaking fish venture programmes [7].Arunachal Pradesh, being the largest state of the North East Region and bestowed with numerous natural resources is mostly based on capture fisheries rather than culturing fishes in confined water bodies [4]. However, the State has a large cultivable fresh water area in the form of ponds, tanks and beels etc., of which ha fragmentary part is being utilized at present for fish culture. Location specific proven technologies for fish production, their processing and marketing by strategic approaches suitable for diverse agro-climatic regions of Arunachal Pradesh is the key for development of aquaculture sector in the state. The constraints of hilly topography, lack of basic farm input facilities, poor road and connectivity, lack of knowledge and skill compels the fish growers of the state in traditionally growing an admixture of fishes in polyculture system where species ratio and water quality management is not been practiced scientifically. Fishes are fed with locally available feed materials like banana leaf, banana pseudo stem, rice bran, cow dung etc., which does not suffice the nutritional requirement [1].Improper stocking density and selection of incompatible fish species further dampens the fish productivity. Therefore, to address the existing aquaculture scenario and the economic loses therein; the Krishi Vigyan Kendra of East Siang district with the host institute as College of Horticulture and Forestry, Central Agricultural University, Pasighat, Arunachal Pradesh has conducted a study on economic feasibility of Composite Fish Culture (CFC) in East Siang District, Arunachal Pradesh at the farmers' field for three consecutive years 2016-2018.

## Materials and Methods
The present study was carried out in four different locations of the district *viz.* Ayeng, Nari, Takilalung and Mirem villages during the years 2016- 2018. Fingerlings of Rohu (*Labeo rohita*), Catla (*Catla catla*), Mrigala (*Cirrhinus mrigala*), Grass Carp (*Ctenopharyngodon idella*), Common carp (*Cyprinus carpio*) and Silver carp (*Hypophthalmichthys molitrix*) were

stocked in a ratio 2 Catla: 2 Rohu: 1.5 Mrigal: 2 Silver carp: 1 Grass carp: 1.5 Common carp [5].

The fishes were stocked at the rate of 7000 fingerlings per ha. The best management practices *viz*. pre-stocking, stocking and post-stocking management were followed. In the pre-stocking management the pond renovation was done through farmers participatory mode, clearance of aquatic weeds were done manually, eradication of predatory and weed fishes were done by repeated netting, liming was done using quick lime @ 250 kg/ha. The advantages of liming is that lime acts as buffer and avoids fluctuations of pH, it accelerates organic decomposition, increase in pH of bottom soil and thereby enhancing the availability of phosphorus added in fertilizer. Manuring of the ponds were done using cow dung 1000 kg/ha after 10 to 15 days of lime application. Application of manuring of pond is an important aquaculture culture activity as it increases the natural productivity resulting increase in total fish production.

After a week of application of manure stocking of fish fingerlings were done. The transportation procedure as well as acclimatization of the fish fingerlings to be release is the key for achieving better survivality. In the present investigation, transportation of fingerlings was done in the early morning hours with oxygen packing from Mini Carp Hatchery located at Dhemaji District, Assam. Acclimatization of the fingerlings was also done by putting the oxygen packed polythene bags in pond water for 30 minutes followed by addition of excess water in the same bag and releasing the fishes slowly in the pond for reducing the stress related to temperature fluctuation. Supplementary feeding of oil cake and rice bran with a mixing ratio of 1:1 was done @ 5-2% of body weight of fishes. Manuring @ 700 kg/ ha and liming @ 200 kg/ ha was also done once in a month for maintaining water quality of the ponds. Sampling for regular health and growth checking of fishes were also done once in every two months. Statistical observation like mean weight of the fishes in different locations, yield per unit area and data for cost evaluation were recorded. For improving knowledge of practicing farmers on aquaculture skill development training and exposure visits were conducted by Krishi Vigyan Kendra East Siang during the culture period.

## Results and Discussion

The Composite Fish Culture (CFC) was found as one of the location specific appropriate technologies for poly culture of fishes in hills. In previous studies also various advantages of CFC for the North Eastern Region of India was described [8]. Among the species culture in CFC, Silver carp was recorded as highest with the average growth i.e. 778 g in eight months of culture period (Table 1). In the case of Indian Major Carps, catla has showed better growth performance with an average growth of 733 g in the same culture period (Table 2). The comparative good growth of silver carp as well as catla may be due to the quantum of plankton production as a result of proper pond liming and manuring [2].The advantages of liming was that lime acts as buffer and avoids fluctuations of pH, it accelerates organic decomposition, increase in pH of bottom soil and thereby enhancing the availability of phosphorus added in fertilizer. It was opined that production of planktons which were basic food for silver carp and catla effects their growth [9]. The average productivity of fishes from different experimental location during 2016 - 2018 was recorded as 19.4 q, 20.2 q and 19.9 q respectively which were lower than the national average. The transportation procedure as well as acclimatization of the fish fingerlings to be released was the key for achieving better survival. The reason behind comparative low productivity than the national average may be due to prevailing low water temperature during October to March (Table 2).

To evaluate the sustainability of poly culture of fishes following CFC, the economic analysis is illustrated in Table 4. The average total cost of production per hectare over the period of 2016-2018 was Rs.1, 46,667. The variation in the cost of production in different years was due to variation in cost of inputs. Gross profit to the tune of Rs. 3, 17,500was recorded with a net profit of Rs. 1, 70,833 per hectare. This gave an average benefit-cost ratio of 2.16. The result reflects that production of fishes by adopting CFC is a profitable venture which is because of adoption of good management practices. It has been reported that those farmers, who have a tendency to maximize their earnings, have higher adoption of Composite Fish Farming System [3].

## Conclusion

The outcomes of the present study revealed that Composite Fish Culture method for fish farming could be a promising venture for proper utilization of land and water resources of East Siang District of Arunachal Pradesh. Adoption of this location specific fish farming techniques will open opportunities for self-employment, nutrition security, and income generation of the farmers as well as will enhance fish production.

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**Table 1:** Average weight (g) of fishes observed in CFC during the study period

| Fish Spp. | Villages under study | | | | |
|---|---|---|---|---|---|
| | Ayeng | Nari | Takilalung | Mirem | Average |
| Silver Carp | 726±50 | 810±62 | 792±58 | 784±48 | 778 |
| Catla | 724±49 | 714±51 | 761±52 | 732±49 | 733 |
| Mrigala | 326±55 | 358±54 | 394±50 | 410±50 | 372 |
| Grass Carp | 691±58 | 664±55 | 589±52 | 642±51 | 647 |
| Common Carp | 510±48 | 521±49 | 498±54 | 457±53 | 497 |
| Rohu | 351±42 | 319±51 | 322±57 | 378±52 | 343 |

Number of Sample (N) =50 for each species in different locations.

**Table 2:** Average water temperature and pH of the pond water in study locations during the study period

| Month | Temperature (ºC) | | pH | |
|---|---|---|---|---|
| | Range | Average | Range | Average |
| January | 17.8 – 19.7 | 19.1 | 5.7-7.8 | 6.7 |
| February | 19.6 – 22.7 | 20.6 | 5.6-7.6 | 6.9 |
| March | 22.1 - 25.3 | 23.6 | 6.1-7.8 | 7.2 |
| April | 23.1 - 27.8 | 25.3 | 5.9-7.7 | 7.9 |
| May | 23.8 - 28.4 | 26.9 | 6.1-8.1 | 7.9 |
| June | 24.2 - 29.1 | 27.1 | 5.9-7.6 | 6.9 |
| July | 25.7 - 29.3 | 27.6 | 5.8-7.7 | 7.3 |
| August | 23.0 - 30.0 | 28.4 | 6.2-7.5 | 7.2 |
| September | 24.4 - 29.1 | 27.6 | 5.8-7.9 | 7.1 |
| October | 24.1 - 27.5 | 25.0 | 6.0-7.8 | 7.4 |
| November | 22.0 - 25.0 | 22.6 | 6.8-7.8 | 7.5 |
| December | 19.0 - 23.0 | 20.1 | 6.7-7.9 | 7.7 |

**Table 3:** Year wise average yield (q $ha^{-1}$) of fishes in CFC during the study period

| Year | Ayeng | Nari | Takilalung | Mirem | Average |
|---|---|---|---|---|---|
| 2016 | 22.1±0.12 | 19.9±0.17 | 17.8±0.16 | 17.9±0.13 | 19.4 |
| 2017 | 22.4±0.14 | 19.7±0.13 | 21.1±0.15 | 17.6±0.16 | 20.2 |
| 2018 | 21.9±0.16 | 20.1±0.18 | 19.7±0.14 | 17.8±0.18 | 19.9 |

**Table 4:** Economics evaluation of fish farming in study area

| Parameter (Average of different location) | CFC | | | |
|---|---|---|---|---|
| | 2016 | 2017 | 2018 | Avg. |
| Total Cost of production (Rs. $ha^{-1}$) | 141000 | 147000 | 152000 | 146667 |
| Mean Yield of fishes (q $ha^{-1}$) | 19.4 | 20.2 | 19.9 | 19.8 |
| Gross profit (Rs.$ha^{-1}$) | 291000 | 323200 | 338300 | 317500 |
| Net returns(Rs. $ha^{-1}$) | 150000 | 176200 | 186300 | 170833 |
| Benefit Cost ratio | 2.06 | 2.19 | 2.23 | 2.16 |

- Sale price of fish per kg was Rs.150, Rs. 160 and Rs. 170 in the year 2016, 2017 and 2018 respectively.
- Total cost of production includes cost of labour for pond preparation and management, fertilization application, liming, netting, transportation of fingerlings and other materials etc. and material cost like fish fingerlings, feed, fertilizer, lime, chemicals etc.

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