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Alterations in the management practices of composite farming of Indian Major Carps in 24 Parganas (N) district, West Bengal

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Abstract
The present status and deviations from the classical management practices of composite farming of Indian major carps (IMC) have been investigated in North 24 Parganas district of West Bengal, India. Classical six species combination, ratio of IMC and exotic carps were not being followed by the farmers in general, as 75% of them cultured carps with 7-10 species with a stoking density of 15000 nos. fingerling ha^{-1}. 71.68% farmers who produced more than 5 tonnes $ha^{-1}yr^{-1}$ stocked their pond twice in a year instead of once. Although the number of species stocked by the farmers was highly variable among the farmers, it was found that six species combination was optimal so, far the production level is concerned ($y= -0.163x^2+2.018x-0.38$; $R^2= 0.68$). Application of 350-400 kg ha^{-1} agricultural lime and 200-250 kg ha^{-1} fertilizer (urea + single super phosphate = 1:1) to achieve annual yield, was found to be optimal towards fish production. Production level declined as the depth of the pond increased from 5 to 9 feet. Inclusion of readily available carbohydrate source like molasses and boiled starch in supplementary feed preparation was conspicuous. Most of the respondents stock a variety of species and many of them (mrigal, bata, black carp, punti, prawn) can effectively use the heterotrophic pathway of production utilizing the benthic detritus, the feed types adopted by the respondents were proved to be beneficial in attaining such satis1factory production level.
Incorporation of variable ingredients with the conventional mixture of rice bran and oil cake proved to be superior as feed than the later usually recommended in composite farming of carps.
The remarkable introductions in the original six species combination were minor carps like bata (*Labeo bata*), Japani punti (*Puntius javanicus*), tilapia (*Oreochromis niloticus*); minor fish like mola (*Amblypharyngodon mola*) carplet and scampi (*Macrobrachium rosenbergii*). Majority of the farmers used to stock more silver carp (*Hypophthalmichthys molitrix*) because of it's high growth rate though it exerted a direct bearing upon catla (*Catla catla*).

Keywords: Composite culture, management practice, 24 Parganas (N)

1. Introduction

India is the second largest country in inland fish production in the world [4]. Besides providing livelihood security to more than 14 million people, aquaculture established itself as one of the major foreign exchange earners, with revenue of Rs.10, 048 crores in 2010-2011 amounting to 18% of total agricultural export from India. The major contribution to the bulk of production over 3.02 million tones comes from Indian major carps, namely catla (*Catla catla*), rohu (*Labeo rohita*) and mrigal (*Cirrhinus mrigala*) [6]. Though the fish production increased from 0.7 million tonnes in 1951 to 8.6 million tonnes in 2011-12 [4] where aquaculture contributed 78% of the country's total fish production India has not yet been able to make use of its diverse potential satisfactorily [9].

Polyculture of compatible fish species is the most ecologically sound fish culture practice which facilitates efficient utilization of all ecological zones within the pond environment enhancing the maximum standing crop [11]. Carp polyculture wherein the species composition with compatible species of Indian major carps (catla: *Catla catla*; rohu: *Labeo rohita*; mrigal: *Cirrhinus mrigala*) and exotic carps together in the same pond known as composite culture was introduced by the Indian Council of Agricultural Research during the 1970s. Introduction of three exotic Asian carps namely grass carp (*Ctenopharyngodon idella*), silver carp (*Hypophthalmichthys molitrix*) and common carp (*Cyprinus carpio*) in India as the component of composite fish culture has resulted in enhanced aquaculture productivity [15, 2]. The production potential and economic viability of carp polyculture in India have already

undergone rigorous tests and thus, stand on a sound footing [14] where production of 4 to 5 tonnes/ha can be obtained in a year. In six species composite culture, the species comprises of rohu (25-30%), catla (10-15%), mrigal (15-20%), silver carp (20-30%), grass carp (5-10%) and common carp (10-20%) in composite fish culture [13]. Fish yield data through a composite culture of IMC and exotic carps was highly variable from 2060 to 8867 kg $ha^{-1}yr.^{-1}$ [10, 15, 1, 8].

Composite fish culture is a proven technology aimed for obtaining higher yield and return from unit area [2]. Significant advances were made in the state of West Bengal in the early nineteenth century with the controlled breeding of carp in bundhs (tanks or impoundments where river conditions are simulated) [12]. Nearly after fifty years of introduction of composite carp farming in India, there is a lack of information on the present status of this culture practice from the farm level itself. Despite of technological support, scientific fish farming has yet to be adopted widely. The reasons are varied and many. In India, village level ponds are the mainstay of aquaculture industry which are managed by the people who are from the lowest strata of the rural community [5].

Several alterations/ modifications in the pre stocking and post stocking management practices from the ones originally advocated during it's inception during the seventies have been made by the farmers based on their own experiences through the ages. Therefore, the present study has been proposed and accordingly designed to assess the present status of the on farm practice of composite farming and how far it has been deviated from the original package of practice.

2. Materials and Methods

The present study has been conducted during February to June, 2014 in the purposively selected North 24 Parganas district (22º11'6"- 23º15'2" N; 88º20' - 89º5' E) of West Bengal, India. North 24 Parganas district was purposively selected as it has vast and diverse inland fishery resources and also ideally suited for taking up scientific fish culture along with well managed composite carp farming. As such there is adequate scope for development in this sector through different discipline and directions for boosting up fisheries and allied activities maintaining ecological balance and attributing due importance to save our wet lands. Moreover, the study area was easily accessible for collection of data through personal interview with the farmers.

Among twenty two Development Blocks in North 24-Parganas, six blocks namely Bagdah, Barasat-1, Bongaon, Gaighata, Habra and Swarupnagar were selected for the present study in the consideration of the preponderance of composite carp farmers among the population. From each of the six selected blocks, two villages each were selected by simple random sampling technique. Therefore, twelve villages served as the representative unit for the study. Numbers of fish farmers from each village were selected by using proportionate stratified random sampling technique. A total of 60 fish farmers comprising a proportionate number from the selected blocks constituted the respondents for the study.

Primary data were collected with the help of structured and pre tested interview schedule developed for this purpose from the respondents on spot through personal interview. The data were analyzed in terms of percentage and frequency against each variable. Appropriate statistical relationship between two variables was fitted for prediction of the degree of relationship between them with R^2 values.

3. Results and discussion

All the respondents practice farming in perennial ponds which are mostly (65%) rain fed. The application rates of any of the inputs were variable and arbitrary in prestocking pond management as 86.67% of the farmers use 3200 kg ha^{-1} mahua oil cake (MOC) as fish toxicant (Fig. 1). Majority of fish farmers (78.33%) eradicate aquatic insect both through repeated netting and pesticides viz. Nuvan (Dichlorvos or 2,2-dichlorovinyl dimethyl phosphate), Ustaad (Cypermethrin) etc. means while the rest only with chemical chemical pesticides (Fig. 2). Two thirds of the fish farmers apply cow dung (@ 10,000-11,000 kg ha^{-1}) as manure before stocking (Fig. 3). Nearly 55% fish farmers apply agricultural lime @ ≥ 350 kg ha^{-1} by broadcasting over their pond without measuring the pH either of water or of soil during prestocking management (Fig. 4). Regarding water quality management, the rate of lime application though varied highly from farmer to farmer, a fitted equation established that a 350-400 kg ha^{-1} of lime application resulted in optimal production in the area of the present study (Fig. 5).

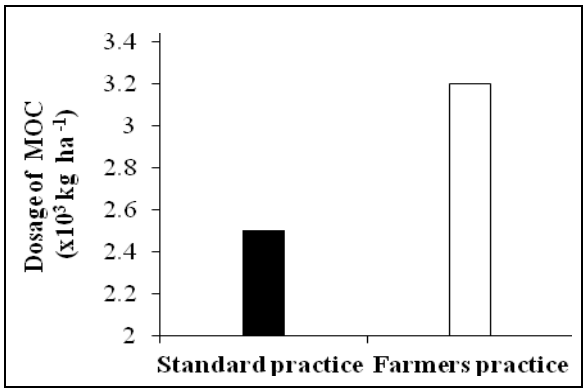

Fig 1: Difference between standard practice and farmers practice regarding mahua oil cake (MOC) application.

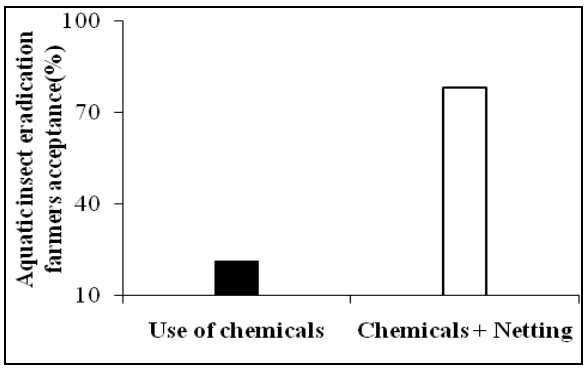

Fig 2: Farmers (%) adopting different means of eradication of aquatic insect

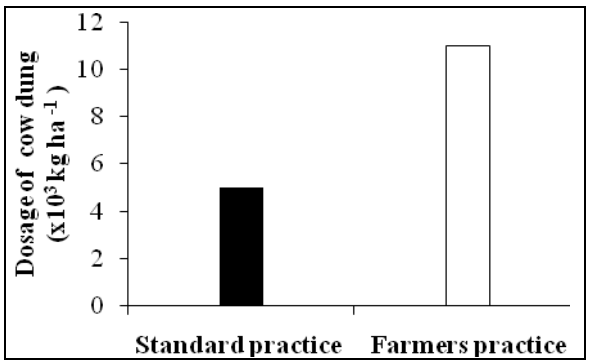

Fig 3: Difference between standard practice and farmers practice regarding cow dung application in pre-stocking management.

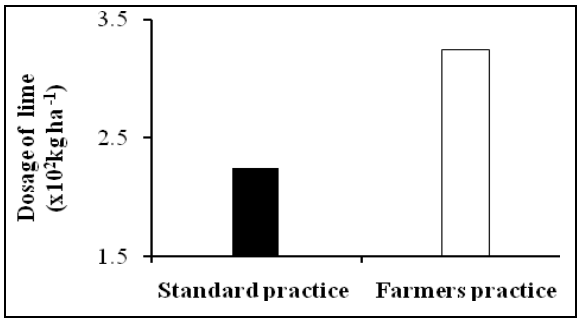

Fig 4: Difference between standard practice and farmers practice regarding lime application.

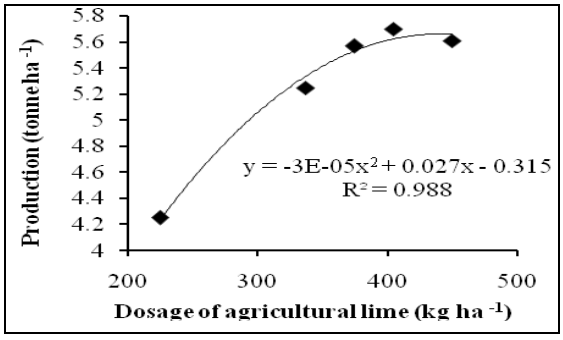

Fig 5: Fitted relationship between dosage of lime and fish production.

As most of the fish farmers having no scientific knowledge about fish farming, 68.34% farmers never tested even the basic physico-chemical quality of pond water like pH, dissolved oxygen, alkalinity etc. Moreover, disinfection of fish seed was never done by any of the farmers. This indicated that the farmers in general were ignored of the importance of all these practices before prestocking management of their farm ponds. Moreover, pond bed management by periodic excavation of mud, dosage of mohua oil cake (MOC), manure and lime as per the standard package of practice were not being followed by the farmers.

Regarding stocking density, species composition, stocking rate and frequency of stocking the farming practice widely varied among the farmers. The classical six species combination and ratio of IMC and exotic carps were not being followed by any of the farmers in the surveyed area (Fig. 6). Nearly 75% fish farmers practiced 7-10 fish species in their ponds (Fig. 7). Though the number of species stocked by the farmers was highly variable, it was found that six species combination was optimal so far the production level is concerned (Fig. 8). Most of the fish farmers (90%) stocked fingerlings with a density of 15000 nos. ha^{-1} which was strikingly high compared to the classical practice (7500-10,000 nos. ha^{-1} (Fig. 9).

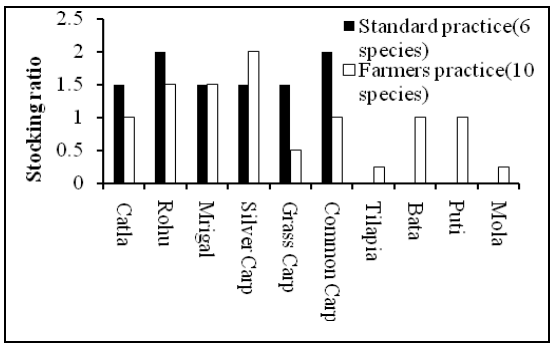

Fig 6: Difference between standard practice and farmers practice regarding stoking ration and 6 and 10 species culture.

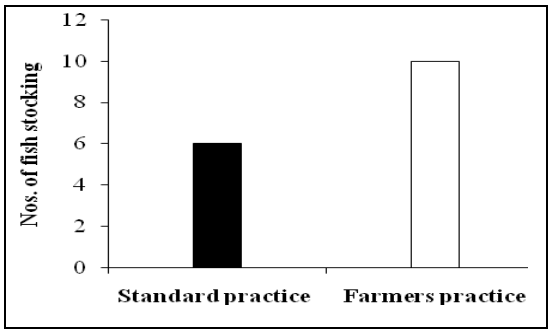

Fig 7: Difference between standard practice and farmers practice regarding no. of stocked fish species.

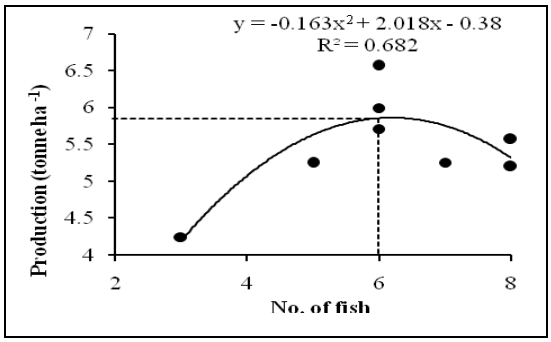

Fig 8: Fitted relationship between numbers of species stocked and fish production.

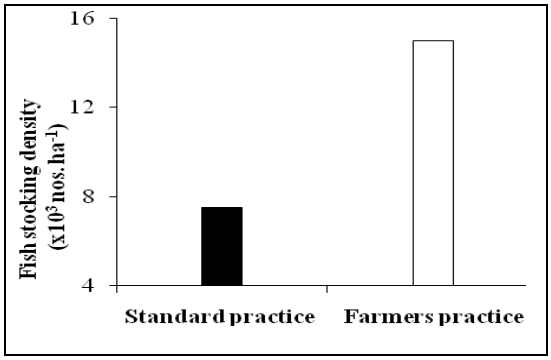

Fig 9: Difference between standard practice and farmers practice regarding fish stocking density.

So far the post stocking management was concerned, none of the farmers used to apply manure during the grow-out period as prescribed for composite farming of IMC (Fig. 10). Majority of the fish farmers (81.67%) apply fertilizers *viz*. SSP and urea for enhancing productivity during post stocking management of carps with no scientific basis with regards to the frequency and dosage. Likewise, among the farmers who used to fertilize their pond though with variable dosages, a dosage of 200-250 kg ha^{-1} $month^{-1}$ was found to be ideal for optimal production beyond which production level declined (Fig. 11). Most of the farmers (79%) provide supplementary feed @ 7.5% of the body weight up to 500 g size of cultured carps (Fig. 12.A) and @ 4.6% of the body weight of 500-1000g size which was a clear deviation from the recommended feeding rate of 4-6% (Fig. 12.B). Satisfactory production levels of 5.17-5.58 tonnes ha^{-1} yr^{-1} achieved by most of the respondents also incorporated either readily available carbohydrate source in the form of dry bread /biscuit crumbs, ground nut oil cake (GOC), mustard oil cake, rice bran or animal sources proteins (Fig. 13). Readily available carbohydrate helps to augment the heterotrophic potential of the aquatic system acting as an energy source [3]. Moreover, there was deviation in feed type also as from the conventional

dry mash type of feed some of the respondents used to apply liquid and floating type of feed as well. The respondents were innovative in their ideas in incorporating variable feed ingredients as per their expertise but with little technical support. As a result, they were not aware of the feed quality, quantity of feeds to be required for their stock, mode and frequency of application. Moreover, majority of the respondents switched over from the conventional type of broadcasting to bag feeding to reduce feed loss and maintaining good water quality. Among the various feed types, supplementary feed with fish meal and molasses resulted in highest production (6.57 tonnes ha^{-1} yr^{-1}) (Fig. 14).

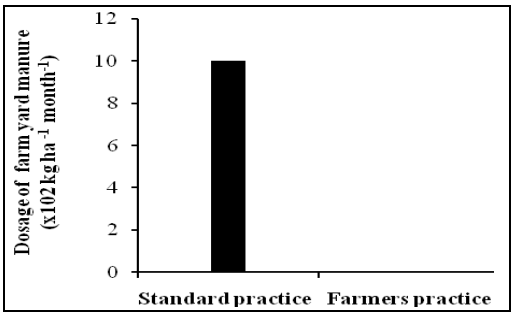

Fig 10: Difference between standard practice and farmers practice of farm yard manure (FYM) application in post stocking management.

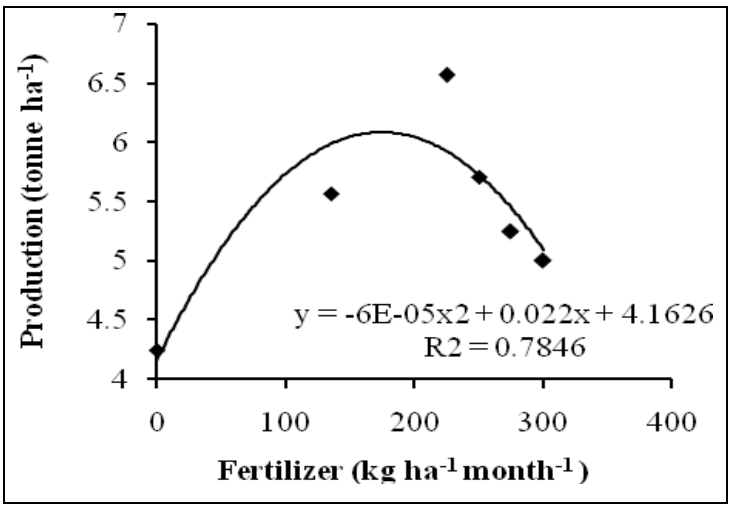

Fig 11: Fitted relationship between application of fertilizer and fish production.

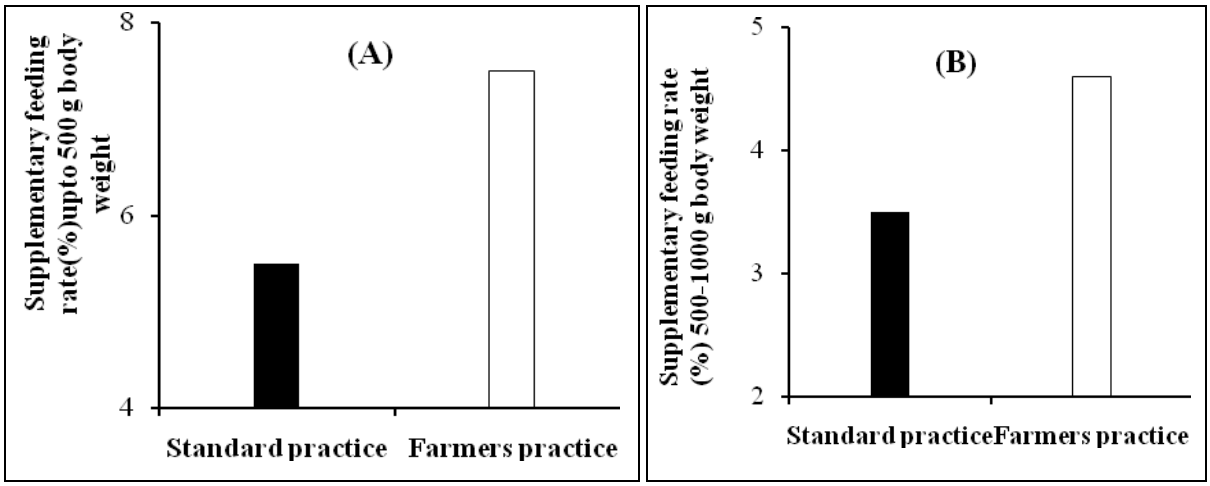

Fig 12 A. & B. Difference between standard practice and farmers practice regarding supplementary feeding (%) of body weight.

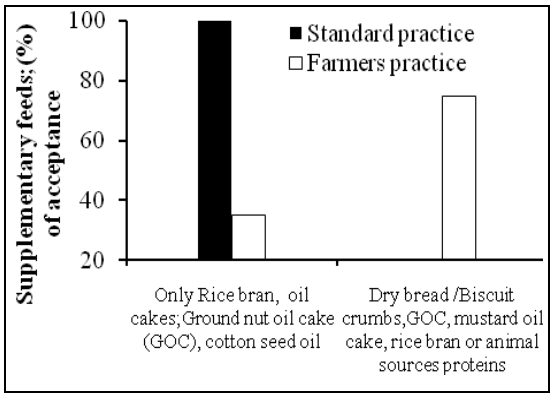

Fig 13: Difference between standard practice and farmers practice regarding supplementary feeding.

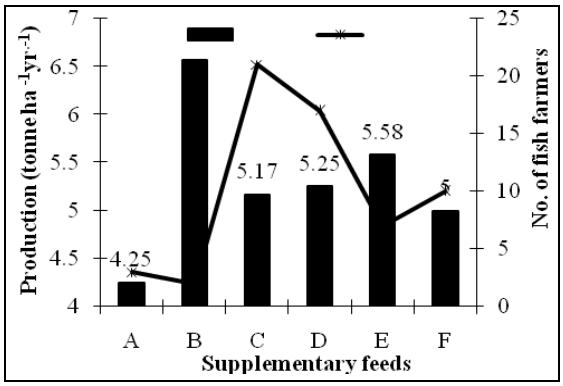

Fig 14: Fitted relationship between fish practice production, supplementary feed and no. of fish farmers.

Regarding annual yield, the majority of fish farmers (78.68%) produced above 5 tonnes ha^{-1} yr^{-1} and the rest (21.32%) below 5 tonnes $ha^{-1}yr^{-1}$. As pond depth was considered as one of the most important factors in productivity [7], in the present study it was found that production level declined as the depth of the pond increased from 5 to 9 feet (Fig. 15). Moreover, the farmers who produced above 5 tonnes ha^{-1} yr^{-1}, stocked fish twice in a year (June and September-October) and the rest stocked only once (Fig. 16 A). Among the farmers who produced less than 5 tonnes $ha^{-1}yr^{-1}$, 88.20% stocked fish once in a year (Fig. 16 B). This implied that, with more stocking and harvesting frequencies, there is scope of further increase in the productivity level. The farmers who produced above 5 tonnes ha^{-1} yr^{-1}, 27% used to stock IMC along with exotic carps (Silver carp: *Hypophthalmichthys molitrix*, Grass carp: *Ctenopharyngodon idella*, Common carp: *Cyprinus carpio*), bata (*Labeo bata*), Japani punti (*Puntius japonicus*), tilapia (*Oreochromis* sp.). Again, 19% farmers preferred a combination of IMC with silver carp, bata, common carp and Japani punti, 16.31% fish farmers preferred IMC with silver carp, grass carp, bata, Japani punti, mola carplet (*Amblypharyngodon mola*), 13.98% fish farmers preferred IMC with silver carp, grass carp, bata and Japani punti, 11.65% fish farmers preferred IMC with silver carp, grass carp, bata, Japani punti and 4.66% of surveyed fish farmers preferred scampi (*Macrobrachium rosenbergii*) with IMC, grass carp, bata and silver carp (Fig.17 A). Contrary to this, the farmers who produced below 5 tonnes $ha^{-1}yr^{-1}$, 41.20% stocked IMC with exotic carps and bata; three species Indian polyculture was maintained by 35.28% fish farmers and species combination was not specific among 23.52% farmers (Fig. 17 B).

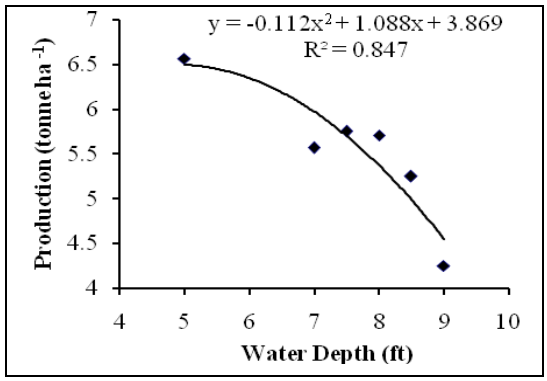

Fig 15: Fitted relationship between depth of water and fish production.

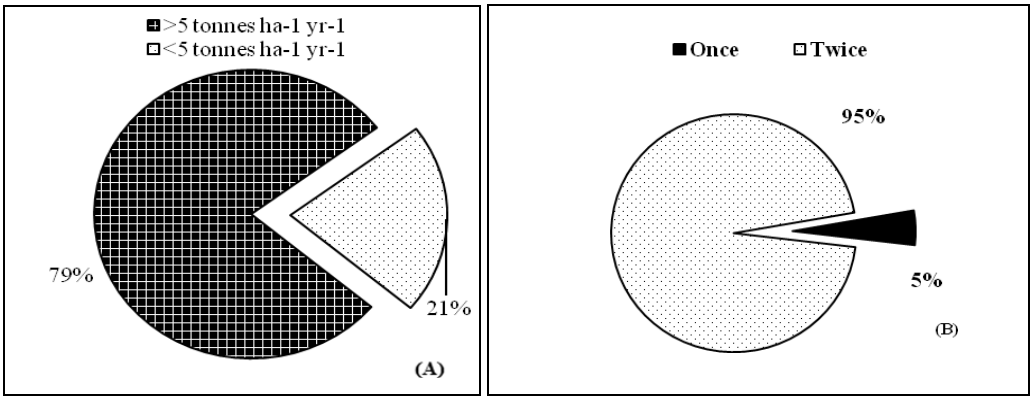

Fig 16: A. & B. Farmers' profile on annual yield and stocking frequency in fish production above 5 tonnes ha^{-1} yr^{-1} (A)and below 5 tonnes ha^{-1} yr^{-1} (B)

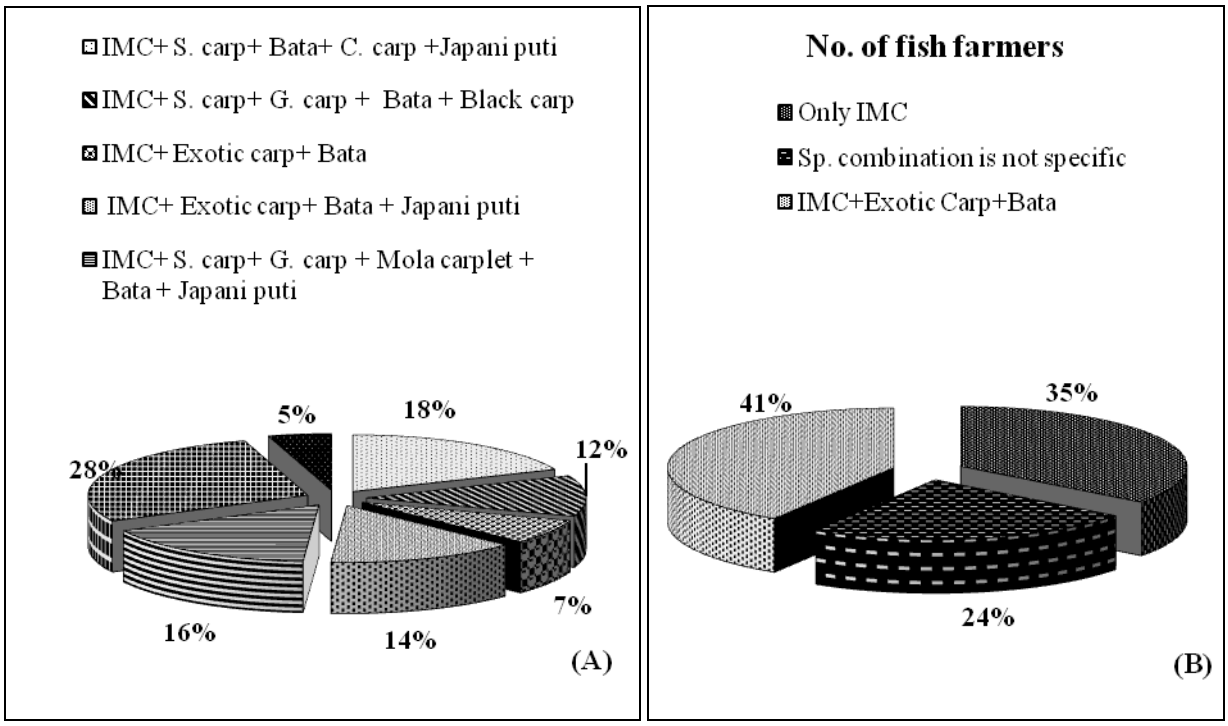

Fig 17: A. & B. Species combination for fish production above 5 tonnes ha^{-1} yr^{-1} (A) and below 5 tonnes ha^{-1} yr^{-1} (B).

It was conspicuous that as the farmers used to stock more silver carp because of high growth rate, it had a direct bearing upon catla both being surface habitants. This was because the former can effectively graze even the nano-phytoplankton at the surface layer which resulted in a negative impact on the next trophic level of zooplanktonic production and ultimately the growth rate of the later being predominantly a zooplankton feeder at the surface layer. Therefore, farmer's perception towards catla as a cultivable species as bad to average was because of the improper stocking ratio of catla and silver carp which needs to be scientifically addressed to the farmers. However, culture of exotic grass carp was problematic to the farmers because of inadequate supply of feed throughout the year though the species has a good growth rate.

Though with such distinct deviations both in prestocking and post stocking management the farmers were achieving highest average productivity level of 5.41 tonnes ha^{-1} yr^{-1}. This indicated that the farmers guided by their own experience incorporated several species in the composite farming of carps which was proved to be economical. The remarkable introductions in the species combination were minor carps like bata, Japani punti and tilapia. It is to be noted here that, mola used to be considered as weed fish which needs to be eradicated as per the standard protocols of six species composite farming. But considering the market price and natural breeding habit the farmers were encouraging mola carplet to enhance productivity and economic profit, which was most noteworthy. In addition to this, the farmer who achieved the highest production (6.57 tonnes ha^{-1} yr^{-1}), used to stock even giant fresh water prawn (*Macrobrachium rosenbergii)* along with carps.

4. Acknowledgement

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5. References

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