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# Factors Influencing Adoption of Scientific Technologies Related to Makhana *(Euryale ferox)*-Cum-Fish Culture in Bihar

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**ABSTRACT**

In India makhana is being cultivated particularly in North Bihar and lower Assam. In spite of availability of profitable and farmers' friendly technology in relation to makhana-cum-fish culture, its cultivation is confined in small pocket of India due to various reasons. The present study made an attempt to study the factors responsible for the adoption of scientific makhana-cum-fish culture technologies. The results of the study showed that 85 percent of farmers adopted makhana-fish farming practices. Correlation analysis of the data revealed that education, type of house and annual income are positively and significantly correlated with production level, whereas physical feature and contour type were negatively correlated with production level. It is found that annual income and type of house are correlated with adoption of makhana cum fish culture practices.

**Keywords:** Adoption, Fish-cum-Makhna, Livelihood, Socio-economic.

## INTRODUCTION

Fisheries sector plays a major role in employment generation, supplementing food supply, increasing nutritional status of the people, livelihood development and earning foreign-exchange through export. Malnutrition poses a major threat to large section of people who remain undernourished due to lack of animal protein at affordable prices. Fisheries and aquaculture provide food security as well as balanced nutrition at a relatively lower price. In India, the importance of aquaculture sector is well known as a provider of livelihood to seven million aquaculturists, the prime mover of the coastal economy and a major foreign exchange earner. Development of several suitable technologies coupled with extension activities during the last five decades has pushed Indian fish production manifold, particularly to become the second largest aquaculture fish producer in the world (Ayyappan *et al.*, 2011).

The state of Bihar has a large area under the water bodies of both lotic and lentic type and having great potential to using chaurs, mauns for development of culture too with the inputs of modern systems and thereby ensuring a successful way of blue revolution in Bihar (Trivedi, 1990, Dehadrai, 1994, Singh, 2001, Singh and Singh, 2002). Against the estimated annual demand of 5 lakh tonnes, the present freshwater fish production in India is only 3 lakh tons (Ayyappan *et al.*, 2011). Hence there is a vast gap between the production and demand. The state of Bihar may be roughly and unequally divided into two parts, North Bihar and South Bihar by the river Ganga, augmenting the prospects of blue revolution in North Bihar could be reality with the adoption of all possible methods of integrated aquaculture as applicable in this area. Waterbody in this zone is known to be a repository of aquaphytes (*i.e.* makhana, deep rice, water chestnut *etc.*) and has emerged as potential one for fish production. As a topic of paramount importance, integrated aquaculture in North Bihar has attracted greater scientific attention (Banerjee, 1972, Dehadrai, 1972, Laal, 1981, Verma *et al.*, 1996). The dead and abandoned courses form the stagnant channels, which are also utilized for cultivation of fish, deep water rice, makhana and other aquatic eatables (Laal, 1981).

Makhana, the wonder pop from aquatic resources, is known as Euryale ferox which is described as a perennial aquatic herb. Ecologically, makhana grows in shallow water bodies which have a certain amount of organic detritus accumulated at the bottom. By far, India is the only country where makhana is being cultivated particularly in North Bihar and lower Assam. Makhana is grown in thousands of stagnant freshwater bodies in about

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a dozen districts of North Bihar. Myriad of ponds and tanks of various dimensions are scattered throughout North Bihar with a water spread area of 39997.16 ha covering 42 per cent of the total water spread area (95116.84 ha in the form of ponds and tanks) of the entire state (Chaudhary and Kumar, 2005). These scattered and isolated water bodies are suitable for rearing and culturing of useful aquatic organisms and plants of high economic importance under controlled or semi- controlled conditions. These can be profitably managed for fish culture as well as for growing water fruits like makhana which are of high nutritive value and relished by the people in India and abroad also. Ecologically, makhana grows in shallow water bodies which have a certain amount of organic detritus accumulated at the bottom. Such water bodies are generally those which occur in rural areas and acquire the characteristics due to man's neglect on one hand and on the other hand due to vagaries of nature. It provides livelihood to thousands of fishing families in the region. It is known for its nutritional and medicinal properties. Various studies on its dietary evaluation have revealed it has a good amount of protein 11.5 per cent with a high percentage of essential amino acid index and chemical score (Jha, 1987, Jha *et al.*, 1991).The crop has attracted the attention of biologists and ecologists in this region (Dutta,1984, Laal and Duttamunshi, 1985).

The integration of fish culture with makhana farming will offer greater efficiency in resource utilization and will reduce risk by crop diversification. This will provide additional food and income to the growers. The importance of the integration of makhana with fish culture will be of special significance as it will improve the socio-economic status of rural fishing community, who traditionally cultivate only makhana and can easily take up makhana-cum-fish culture, if proper incentives are given. In makhana-cum-fish culture, since makhana is the main crop, fish culture has to adopt the conditions and requirements of the makhana crop. To grow fish in makhana ponds successfully, it is essential to have complete control over the water levels and drainage facility. Ponds where Makhana is cultivated are swampy and more or less unsuitable for carp culture. Air-breathing fishes, however by virtue of the presence of accessory respiratory organs can thrive well in such adverse, low-environmental conditions. It is a common proverb that the air-breathing fishes and such ecologically disrupted ecosystem are probably made for each other by nature itself. The benefits of integrating fish with makhana crop are conservation of water resources and plant nutrients, intensive production of fish protein and reduced operating costs relative to either system in isolation.

In spite of the technology of makhana-cum-fish culture is very profitable and its spread has remained insignificant due to various reasons and limitations. The present study is therefore designed to investigate some factors which are related with the adoption of the technology of makhana-cum-fish culture, so that the knowledge could be used in rapid diffusion of the technology to the fish farmers which in turn will help to improve socio-economic conditions of rural people of Bihar and will help to solve unemployment problem.

## METHODOLOGY

The Darbhanga district (under Mithilanchal zone) of Bihar was purposively selected for the present study as the area is potential for makhana-cum-fish culture practices and more or less homogeneous with respect to socio-cultural and socio-economic conditions. Further no research work was conducted in the line of present study in the state. Therefore, it definitely be helpful for policy makers to adopt policy to boost up the fisheries sector of Bihar.

The nature of the study demanded that the respondents should be farmers engaged in fish culture in addition to their main agricultural profession. Hence, the selected villages were visited by the researcher personally. Darbhanga district consists of 18 blocks. Out of 18 blocks, 10 blocks namely, (i) Baheri (ii) Bahadurpur (iii) Singhwara (iv) Hayaghat (v) Hanuman Nagar (vi) Manigachi (vii) Tardih (viii) Kewati (ix) Benipur (x) Bahera were selected purposively as these blocks are having highest concentration of makhana farmers. A list of farmers in these mentioned blocks were prepared. A list of 1000 makhana farmers in these 10 blocks was prepared and 80 farmers were randomly selected without replacement technique.

Based on the literature available and discussion held with the extension officials of the department of fisheries and the staff of Faculty of Fishery Sciences, Kolkata and Central Research Institute for Makhana, Darbhanga, Marine Products Exports Development Authority (MPEDA), a list of independent variables were prepared. Keeping in view the objectives of the study, adoption of makhana-cum-fish culture was considered individually to know its influences on the independent variables. The independent variables selected for this study were - Age (X1), Gender (X2), Educational status (X3), Family type (X4), Family size (X5), Fish eating behavior (X6), Caste profile (X7), Occupational status (X8), Annual income (X9), Type of house (X10), Farming experience (X11), Labour (X12), Physical feature (X13), Formation (X14), Contour type (X15), Filling of water (X16), Use of fertilizer (X17), Use of medicine (X18), Feed (X19).

Production of raw makhana (Y1) and Adoption of makhana-fish culture practices (Y2) was selected as dependent variables. Mean, standard deviation, and analysis of correlation coefficient were used for interpretation of data.

## RESULTS AND DISCUSSION

It is generally believed that the fish farmers vary greatly amongst themselves with respect to socio-economic characteristics. At the outset it was intended to have some idea of the characteristic which shall serve as background information for the fish farmer. For this purpose, the percentage, range and mean values relating to the different independent variables were studied. A total of 19 independent variables and 2 dependent variables were selected for this study.

The results of the study revealed that the majority of the respondents (67.5 %) belonged to middle age category followed by 17.5 per cent were young and only 15 per cent were old. Majority of them were male and there was no involvement of female in the sector of makhana culture. Majority of farmers (71.25 %) were from Economic Backward Classes (EBC) followed by Other Backward Classes (OBC) (15 %), General (GEN) (12.5 %), and Scheduled Caste (SC) (1.25 %) and there were no respondents under the Scheduled Tribe (ST) category. Maximum numbers of farmers (35 %) were having middle level of education, followed by collegiate level (27.5 %), secondary level (26.25 %), primary level (1.25 %). Whereas, 10 per cent of them were illiterate and finally there were no functional literate respondents. 75 per cent respondents belonged to nuclear family, followed by joint family 25 per cent. This distribution might have significantly influenced the size of the family too. Hence, it was found that most of the families have above 5 members (97.5 %) and remaining 2.5 per cent families have below 5 members.

It was conspicuous form the study that the maximum numbers of farmers (98.75 %) were non-vegetarians and they preferred fish. The results indicated that all the respondents engaged in makhana cum fish culture practices as their primary occupation. It was found that majority of respondents (88.75 %) were earning Rs. 48,040 to 1, 51,760 annually. More than half of the respondents (58.75 %) had concrete building and the remaining 41per cent were lived in kuccha house. From the findings of income and house type it can be inferred that majority of the respondents had better economic condition. Majority (65 %) of the respondents had 8-25 years of makhana cultivation experience and 20 per cent of the respondents had above 25 years of experience. About 15 per cent of respondents had up to 8 years of farming experience. The above findings are in line with the findings of Setty (2001), Maheswari (2003) and Sathishkumar (2008).The results revealed that all the respondents were carried out the works related to cultural practices by labourers. Hence, it can be said that, these practices are totally dependent on the availability of human labour.

As far as the Physical feature of resources was concerned, maximum culture practices of makhana were being carried out in ponds (82.5 %) followed by chaur (wetland area) 17.5 per cent. The results of the study indicated that water resources in the study area were mostly man-made and only 13.75 per cent were natural water bodies. Hence, the man made resources were constructed according to cultural practices of respondents. More than half of the respondents (56.25 %) were dependent on rain and 43.75 per cent of respondents were dependent on other sources like deep tube well for filling their water bodies for culture of makhana. It was evident from the study that 55 per cent, respondents were using fertilizers in their water bodies whereas, 45 per cent were not using it as after decomposition of makhana plant the organic load increased so, they didn't use fertilizers in their water bodies.

### Adoption of Makhana-Cum-Fish farming practices

It could be seen from Table 1, that maximum numbers of respondents (85 %) adopted makhana cum fish culture technology.

**Table 1: Distribution of Makhana-Cum-Fish farming practices according to adoption**

**n=80**

| Category | Number | Percentage |
|---|---|---|
| Adopted | 68 | 85 |
| Non adopted | 12 | 15 |
| Total | 80 | 100 |

### Relational Analysis

Correlation between the production of makhana, adoption of the f makhana-fish culture practices and some of the independent variables were done to find out the relationship between them.

Correlation analysis (Table 2) revealed that out of 19 independent variables taken for analysis, only education, type of house and annual income were positively and significantly correlated with production level at 1% level of significance, whereas, physical feature and contour type were negatively correlated with production level at 1% level of significance. The study further revealed that age, family type, family size, caste, farming experience,

labour, formation of resources, source of water, usage of fertilizers and usage of medicines were not correlated with production level of makhana.

**Table 2: Correlation between independent variables with production of Makhana-Cum-Fish as dependent variable**

n=80

| Independent Variables | Pearson Correlation Coefficient |
|---|---|
| Age(X1) | -.102 |
| Education(X3) | .293** |
| Family type(X4) | .150 |
| Family size(X5) | .019 |
| Caste (X7) | .095 |
| Annual income (X8) | .978** |
| Type of house (X10) | .329** |
| Farming experiences (X11) | -.091 |
| Labour (X12) | .173 |
| Physical features (X13) | -.341** |
| Formation of resources (X14) | -.179 |
| Contour type (X15) | -.301** |
| Source of water (X16) | -.123 |
| Use of fertilizers (X17) | .169 |
| Use of medicines (X18) | .101 |

** Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).

Age has negative and non-significant correlation with the production of makhana and adoption of makhana-fish farmers in Darbhanga District. The results are corroborated by the findings of Ponnappan (1982), Krishnna (1988) and Goswami (2010). Annual income exhibits a positive and significant correlation with the production of makhana and adoption of the makhana-fish farmers in Darbhanga District. These findings are in agreement with the observations by Goswami (2010). The education level of the fish farmers shows a positive and significant correlation with production of makhana in Darbhanga District. Similar findings were reported by Goswami (2010). Table 3 further reveals that only annual income and type of house were correlated with adoption of makhana cum fish culture practices, whereas, age, education, family type, family size, caste, farming experience, labour, physical features, formation of resources, contour type, source of water, usage of fertilizers and usage of medicines were not correlated with adoption of makhana-fish culture practices.

**Table 3: Correlation of different independent variables with adoption of Makhana-Cum-Fish culture practices as dependent variable**

n=80

| Independent Variables | Correlation coefficient Pearson coefficient |
|---|---|
| Age (X1) | -.084 |
| Education (X3) | .098 |
| Family type (X4) | .162 |
| Family size (X5) | -.067 |
| Caste (X7) | -.029 |
| Annual income (X8) | .334** |
| Type of house (X10) | .288** |
| Farming experience (x11) | -.030 |
| Labour (X12) | .032 |
| Physical features (X13) | -.009 |
| Formation of resources (X14) | -.066 |
| Contour type (x15) | .006 |
| Source of water (X16) | .018 |
| Use of fertilizers (X17) | .042 |
| Use of medicines (X18) | -.032 |

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.01 level (2-tailed).

The technology of makhana-fish cultivation could be adopted by any fish farmer irrespective of age, educational level, family type, family size, caste, house, farming experience and requirements of labourers. It was also irrespective of physical features, formation, contour type, water filling source, use of fertilizers and medicines by the respondents. The production was high which could ensure good income for the respondents. The production and adoption of the technology of makhana-fish cultivation was only related with annual income of the fish farmers.

## CONCLUSION

The delicious and nutritious quality of makhana has not been properly made known in the major domestic and international market till now. In north Bihar, there is a large number of unutilized derelict water bodies and the most suitable practice to harness these potentialities are integrated fish culture with makhana, because number and biomass of makhana crop except seed is removed from the water body and the decomposed plant residues, called autochthonous type of organic matter, not only supplies the required nutrients to the next crop but also help to grow organic detritus which are consumed by bottom dwelling fishes and provide shelter to young ones to avoid cannibalism. The suggestions given by the fish farmers to promote makhana – fish integration include the establishment of a soil and water testing centre, need of arrangements for imparting training about improved makhana-fish culture practices, availability of good quality seed and feed, suitable crafts and gears for harvesting purposes, establishment of processing plant, establishment of a government regulated fish market, and credit facility at low rate by different credit organizations. These suggestions were further corroborated with different experts, scientists and faculty members.

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