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"AQUACULTURE FOR FOOD SECURITY AND POVERTY ALLEVIATION OF RURAL COMMUNITIES" A CASE STUDY

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ABSTRACT
The existing and potential contributions of aquaculture to food security have been well recognized. Tidwell and Allan (2001) provided some statistics as to the contribution of fish products to food supply and accordingly around one billion people worldwide rely on fish as their primary source of animal protein. Fish supplies 17 percent of animal protein in Africa; over 36 million people are employed directly through fishing and aquaculture; consumption of food fish has increased from 40 million tonnes in 1970 to 86 million tonnes in 1998 (FAO, 1999); and fish consumption is expected to reach 110 million tonnes by 2010 (FAO, 2001). As pointed out by Tacon (2001), aquaculture is "an important domestic provider of much needed high-quality animal protein and other essential nutrition (generally at affordable prices to the poorer segments of the community)". Ahmed and Lorica (2002) found "clear evidence of positive income and consumption effects of aquaculture on households" in Asia's experience. From the perspective of fish farmers, Edwards (1999a, 1999b, 2000) summarized aquaculture's contribution to the livelihoods of the rural poor into "direct" and "indirect" benefits, with the former including the provision of high-quality food, (self) employment, and incomes; and the latter including food supply to local markets, employment opportunities for local communities, efficient resource utilization, and enhancement of farm sustainability through infrastructure construction and (farming) technology innovations. Brummett and Williams (2000) pointed out that high population growth, low elasticity of demand for fish and static fishery production make aquaculture an important supply source for fish products.

KEYWOROD: important domestic provider, food security, livelihoods, "direct" and "indirect" benefits, efficient resource utilization, self-employment.

INTRODUCTION
It has been remarked that science must help us to improve production, natural and human resources can be profitably developed and equally shared, to create more employment and reduce drudgery, to strengthen nation and reduce vulnerability. As per the scientific policy of Government of India, the need of our country is to utilize the resource potentials for enhancing the economic development of the country. This will result ultimately in increase of per capita income, per capita production, per capita consumption and better socio-economic condition of the people. This increase in per capita production and consumption will reduce malnutrition and vulnerability to disease among people. The diet of an average Indian is very low in calories; the animal component in it is alarmingly deficient. Therefore, the main food required is animal protein. Fish protein is supposed to be the cheapest and of superior quality as it contains all the essential amino acids for body building than plant proteins.

"Aquaculture" is one of these; a sector that has not only achieved regular annual growth on a global basis but is also continuing its expansion. Aquaculture is anticipated to account increasingly for the short fall in aquatic food supply that would result from the population increase projected until 2025 and the leveling off, if not the dwindling, of the returns from wild fisheries. Aquaculture is often seen as an important primary production sector from the food security, poverty alleviation, socio-economic and industrial viewpoints. But the further growth and development of this sector in the new millennium will be forced to occur within a different socio-economic status. The "core paradigms" of the sector will have to be different from those of the previous 20 years and therefore, the strategies have to be equally different andinnovative. During the last five decades, Indian fisheries has made great strides, with the

annual production increasing from0.75 million tons of fish and shell fish in 1950 toabout milliontons in the year 2003, indicating overeight-fold increase during the period. The share of inland fisheries sector, which was 29% in 1950 – 51, has gone up to over 50% at present. While production from marine sector has solely been contributed by capture fisheries, aquaculture contribution in inland fisheries sector has been significant in recent years, further, while the production from capture fisheries during last two decades has grown by only 72%, i.e. from 2.08 million tonnes in 1980 to 3.59 million tonnes in 2003, the aquaculture sector has shown a overwhelming growth of 468% during the same period, i.e. o.37 million tones in 1980to 2.1 million tonnes in 2003. The country has also emerged as one of the giants in export front, recording a peak during the year 2000-2001, with earnings of Rs. 5957 corers (US$ 1.25 billion) which however showed a decline of 7.56% during 2003 due to economic recession and drastic decline in price realization of black tiger prawn in international market.

Status of Fisheries in Orissa

During 2003-04, the total fish production of the state was 3, 06,902 tonneswith an overall increase during the past 4 years from 2000-01 to 2003-04 was in the order of about 56,000 tonnes. The present level of fish production in the state is only about 59.7% of the overall fisheries potential of 5.14 lakh tonnes. A comparison of the fish production data of Orissa with her neighbors in the east coast and three on the west registered a lower value even though potentially rich in resources issue.

Shrimp farming is one of the most outstanding commercial success stories in the history of Asian aquaculture which currently produces 82% of the global culture shrimp volume. After the fishes, the crustaceans stand second in mariculture of which the shrimp are the most delicious and demanding species. Shrimp farming in India has undergone a long voyage from traditional culture in swamps and lagoon to semi-intensive farming in scientifically designed farms. Extensive, modified extensive, semi-intensive and intensive shrimp culture systems exist side by side in most of the major shrimp producing countries. Women in Indian society had a distinct place of honour during ancient time. Marine fisher folk are the people who belong to the disadvantaged community of the society; particularly women are given low status even though they are the main resource for development. Women participate in different areas of fisheries including prawn peeling, fish curing, drying, net making, fishing in the canals, clam shell collection and fish marketing are the major areas of women's participation. About 5 lakhs of women population is estimated to be engaged in the fishery related activates (The Hindu).

MATERIALS AND METHODS

A comprehensive case study on the extensive system of Integrated carp culture was carried out in Jemadeipur Sasan of Shrimp farming is one of the most outstanding commercial success stories in the history of Asian aquaculture which currently producing 82% of the global culture shrimp volume. After the fishes, the crustaceans stand second in mariculture of which the shrimp are the most delicious and demanding species. Shrimp farming in India has undergone a long voyage from traditional culture in swamps and lagoon to semi-intensive farming in scientifically designed farms. Extensive, modified extensive, semi-intensive and intensive shrimp culture systems exist side by side in most of the major shrimp producing countries. Women in Indian society had a distinct place of honor during ancient time. Marine fisher folk are the people who belong to the disadvantaged community of the society; particularly women were given low status even though they are the main resource for development. Women participate in different areas of fisheries activities from prawn peeling, fish curing, drying, net making, fishing in the canals, clam shell collection and marketing. According to an estimate about 5 lakhs of women population is estimated to be engaged in the fishery related activates (The Hindu).

Purussottampur block of Ganjam district about 20km. away from the block where a fish farmer was being engaged in paddy-cum-fish culture with extensive type of carp culture. In 1 acre farm area the stocking density adopted (2008-09) 1700 catla, 4000 Grass carp fingerlings with 10,000 *Macrobrachimrosenbergii* with introduction of a new variety of paddy named (Durga). A comprehensive case study on the modified extensive culture of carps was conducted since 2007 as an income generating source in 3 stocking and 1 nurserypond.

Another case study on the intensive culture of carps was carried out in Padmabati village of Purussottampur block of Ganjam district since 2006 in a 120 acres area involving three stocking ponds of 32-acre, 33 acre and 35-acre and one nursery pond of 7-acre area. The pond preparation includes organic and inorganic manuring with bi- species culture system with rohu being dominant (80-90%) and catla being10-20%. The yearlings of catla (60, 000 nos.) and Rohu (3, 00,000 nos.) were stocked based on the carrying capacity and level of management during May – June. Supplementary feeding included DOB (Deoiled Rice Bran), GNOC (Ground Nut Oil Cake), til cake, soya bean were given once in a day by feeding bags. Some vitamins also added to the feed to add nutritional quality of feed (Pillay, T.V.R., 1990). Feed cost contribute more than 60% of the total expenditure. Harvestingdone after grow out period of 8 months during whic fish attained a marketable size of 2 – 2.5kg.

Another comprehensive case study on carp seed production for rural aquaculture development was carried out. Seed production started from 2003-04 in a 45 hector area. The area possess sevenbrood stock pond of 0.6 hector each, 17 number of nursery pond of 0.2 – 0.3 hector each, 4 numbers of rearing pond of 0.2 – 0.4

hector. Mostly IMC (catla, Rohu, Mrigal, Labeocalbasu) and Chinese carps were considered for breeding For both intensive nursery and rearing is done with a high stocking density of 30 lakhs/ha following pre stocking management which included bleaching and liming in dry pond. The pond was treated with Mahua oil cake, multiplex fertilizer, GNOC, RCD etc. The fishes were fed with rice bran (20%) and GNOC (20%) at a rate of 15 – 20 kg per day following filling with water. The fry and fingerlings were harvested separately during June – October. The seeds were transported to the districts like Ganjam, Kendrapara, Nayagarh, Jagatsingpur etc. to be stocked in farmer'sponds. bleaching and liming in dry pond. The pond was treated with Mahua oil cake, multiplex fertilizer, GNOC, RCD etc. The fishes were fed with rice bran (20%) and GNOC (20%) at a rate of 15 – 20 kg per day following filling with water. The fry and fingerlings were harvested separately during June – October. The seeds were transported to the districts like Ganjam, Kendrapara, Nayagarh, Jagatsingpur etc. to be stocked in farmer's ponds.

Monitoring of hatchery operation and selective brood stock management yielded better fecundity and fertilization, survivility hatching and spawn production. Recovery of fry and fingerlings from the nurseries also registered better average with management practices adopted (Table. 1.). A comprehensive case study on shrimp seed production was carried out in OSSPARC (Orissa Shrimp Seed Production, Supply and Research Centre), a unit of MPEDA, Govt. of India, Gopalpur of Ganjam Distict. OSSPARC now producing for the first time in India disease (WSSV, MBV and LB) and banned antibiotics (Chloramphenical and Nitrofuran) free healthy tiger shrimp seeds under biosecured production facilities – and GMP (Good Manufacturing Practices). It was started since 1988. M/s AQUATIC FARMS LTD., Hawaii, USA, one of the best internationally known consulting farms, is helping OSSPARC for producing the disease and antibiotic free seeds. Adequate care was taken in selecting best quality wild brood stock from the landing centres. Maturation of wild tiger shrimp was accomplishedby eyestalk ablation. Instead of ready spawner induced spawner was maintained in one tank for spawning. After spawning, samples of all the spawners wera screened for WSSV. Great care were taken for harvesting and washing of eggs to make them free of infection and then stocked for hatching. Freshly hatched nauplii reared under biosecured environment and probiotics were used during rearing to protect the larvae from infestation of viruses and bacteria etc. Specially designed and comprehensive filtration technique adopted to filter the sea water before use. Highly nutritious algae and carefully produced artemianauplii are used for feeding larval stages. Selected micro encapsulated diets were used for supplementary feeding. Larval stages were tested daily for MBV and LB and Post larvae were subjected to screening for viruses and bacteria and for stress beforepacking.

RESULT

Observations with regard to pond preparation, stocking, harvesting and profit were evaluated through different culture system in the case study and the same is presented in this chapter: Following extensive system of carp culture, the pond was prepared by the use of cow dung with no specific dose. In modified extensive culture mode, cow dung slurry, lime and GNOC were used for phytoplankton and zooplankton production while during intensive system of carp culture, increased dose of cow dung / poultry manure (4 trucks) was applied along with inorganic fertilizers such as urea, lime, SSP, common salt till the end of the culture period with a gradually decreasing rate. Details of manuring and fertilization scheduleare presented in table no. 2.

Altogather 3.6 lakh yearlings were stocked. Supplementary feeding which was negligible during extensive was at the ratio of 1:1 (rice polish and GNOC). In intensive culture system, priority was given for supplementary feeding like DOB, GNOC, and RP. Through extensive system the production was 1 ton fish; prawn 600kg and paddy was 20-30 quintal. at a marketable size of 1-1.5 kg 100-150gm for fish and prawn. In modified extensive system production was 4.5 ton with an average of 1-1.5 kg. But in intensive system production was 4.5 tons/acre in 2007 against present avg. of 5 ton/acre with avg. size being 2-3.5 kg indicating better price as compared to other culture system.

The carp seed production unit consisting of brood stock pond, nursery pond and rearing ponds are prepared by
For all types of pond management included clearing weeds by applying weedicide (2,4-D) @ 4.5 – 6.7 kg/ha and removal of predatory and weed fishes by applying fish poison such as Mahua oil cake and derris root powder @ 3000 kg/ha at least 2 weeks before stocking. Manuring included first liming @ 200 kg/ha followed by organicmanuring with RCD @ 10 – 15 tons/ha, multiplex @ 1 kg/ha. During pre – stocking management first natural foods were developed by applying RCD (@ 2000 kg/ha), GNOC (@ 300kg/ha), multiplex (@ 1kg/ ha) and later supplementary feed (80% rice bran + 20% GNOC) @ of 15 – 20 kg./ day were given once / day.

Rearing of fry and fingerlings of catla, rohu, mrigal, silver carp, common carp and *Labeocalbasu*is done in happas and are harvested when they attain a size of 45-100mm The details of carp seed production is given

in table no (1) which indicates that traditional hapa hatching of spawned eggs is less efficient resulting in poor recovery of spawn as compared to modern breeding technique in Chinese hatchery and nursery management which enhances the hatching efficiency.

In recent years appreciable developments have been made in aquaculture of shrimps all over the world by using probiotics which act as antibiotics. Probiotics acts by stimulating the immune system and providing

essential nutrients to enhance the nutrition of cultured animal and also improves water quality by modifying microbial community composition of water and sediment. The details of probiotic application during larval rearing of shrimp are given in table no (3).

The shrimp seed production was conducted in 6 tanks measuring 5-6 lakh/10 tonner stocking density. (1 ton = 10 tonner) The survivility rate estimated to be 60% indicating more profit margin. The production level and survivility rate of shrimp larvae are presented in table no.(4).

Table 1: Brood Stock Management and hatchery operation.

Air Temperature	**28˚C**	**28˚C**	**28˚C**	**28˚C**	**28˚C**	**28˚C**	**28˚C**
Water temperature	**31.3˚C**	**31.3˚C**	**29˚C**	**29˚C**	**29˚C**	**29˚C**	**31˚C**
Species	**Catla**	**Rohu**	**Mrigala**	**Silvercarp**	**Grasscarp**	**Common carp**	**Labeo calbasu**
No.of female brooder (by wt. & no.)	16kg, 6nos.	9kg, 3nos.	14kg, 9nos.	6kg, 3nos	8kg, 6nos.	3.5kg, 1nos.	8kg,3 nos.
No.of male brooder (by wt. & no.)	28kg, 16nos.	11kg, 11nos.	27.5kg, 15nos.	13kg, 12nos.	16.5kg, 15nos.	1.5kg, 1nos.	10kg, 10nos.
Inducing agent	ovaprim	ovaprim	ovaprim	ovaprim	ovaprim	ovaprim	ovaprim
Dose applied per kg.body wt. for female	0.3 ml.	0.3 ml.	0.3 ml.	0.3 ml.	0.2 ml.	0.1 ml.	0.3 ml.
Dose applied per kg.body wt. for male	0.5 ml.	0.4 ml.	0.5 ml.	0.4 ml.	0.3 ml.	0.2 ml.	0.4 ml.
Total quantity of egg collected	12 lit.	14-15 lit.	16 lit.	10-12 lit.	13-14 lit.	-	12 lit.
No.of water hardened egg/lit	23,000	26,000	23,000	26,000	18,000	3400	30,000
Total no of eggs	25,000	26,500	23,500	26,000	25,000	15,000	30,000
Total no of fertilized eggs	1,33,8600	5,85,000	18,40,000	8,45,000	7,20,000	8,33,000	9,00,000
Percentage of fertilization	60%	50%	80%	50%	40%	70%	80%

Table 2: Fertilization Schedule & Plankton Growth (Pond area/acre with 1.3mt water depth).

Raw material	**Quantity (Kg./hector)**	**Duration (In month)**	**Varieties of plankton**
Raw cow dung	2000	1	Zooplankton
Ground nut oil cake	300	1	Zooplankton
Multiplex	1	3-4	Phytoplankton
Mahua oil cake	3000	1	Phytoplankton

Table 3: Probiotics Application.

Aqualact	**Feed probiotics**	**365/0.5kg**
Biolact	Feed probiotics	648/kg
Growell	Feed probiotics	895/kg
Super-lact	Feed probiotics	306/2kg
Silver PS	Water probiotics	326/2kg

Table 4: Production and Survibility of shrimp.

Tanks (No.)	**Stocking Density Per 10 toner, lakh/10 toner**	**Survivility (%)**
1	5.4	59
2	5.8	62
3	6.2	60
4	5.7	58
5	6.3	64
6	6.0	62

N.B: - (1 tank =10 toner) (Table No.4)

DISCUSSION

Aquaculture in India has witnessed significant development over last 2 decades and now has turned into a lucrative industry. The contribution of fresh water aquaculture forms a major share of over 95% in terms of quantity. The 3 IMCs (Catla; Rohu and Mrigal) constitute as much as 1.8 metric tonnes, out of the 2.2 mt of total production. On the other hand, brackish water aquaculture has dealt with a single commodity of shrimp which has given better production for domestic and exportmarkets.

In general terms, aquaculture may benefit the livelihoods of the poor, either through an improved food supply or through employment and increased income; benefits being either direct through household farming aquatic product or indirect from the increased availability of low-cost fish in local markets or from employment within the aquaculture sector (Edwards, 1999). However at present, little or no hard statistical information exists concerning the scale and extent of rural or small scale aquaculture development within most developing countries and LIFDCs (Low income Food Deficit Countries) or concerning the direct or indirect impact of these and the more commercial scale farming activities and assistance projects on food security and poverty alleviation (Edwards, 1999). However, the explanation of Edwards (1999); “rural aquaculture contributes to the alleviation of poverty directly through small-scale house-hold farming of aquatic organisms for domestic consumption or income; or indirectly though employment of the poor as service providers to aquaculture or as workers on aquatic farms of wealthier farmers; or indirectly by providing low-cost fish for poor

rural and urbanconsumers" is very much relevant in the context recent findings.

Despite the lack of information concerning the role of rural aquaculture, there is one sure benefit of consuming fish and that is nutritional as food fish having a nutrient profile superior to all terrestrial meats. Besidesbeing an excellent source of high quality animal protein and highly digestible energy, it also acts as an extremely rich source of omega-3 PUFAs, fat soluble vitamins (A, D and E) and water soluble vitamins (B-complex) and minerals (Ca, P Fe, I and Se). In fact, if there is a single food that could be used to address all of the different malnutrition disorders; it is fish – the staple animal protein source of traditional fisherfolk.

Indian carp culture scenario has shown mainly 3 types of cultue namely low input extensive culture, medium input modified extensive culture and high input intensive culture. During the present review work, the extensive system carried out by a farmer at Pandia, Purussottampur block with paddy-cum-fish culture has set up an example for others to follow. The farmer has invested only Rs. 20,000 for the critical inputs like seed, feed and manure. But management strategies followedby the farmer aims at gaining a net profit of about 1lakh from sell of paddy, fish and prawns. The most interesting part is the eco-friendly culture practice which scissored the use of insecticide and pesticide very often used in paddy fields.

This system can be adopted by any farmer in the rural sector cultivating rice in low land with water logging.

The modified extensive system of carp culture with candidate species of IMC and exotic carps have undergone several experiments in different geographical locations of the country by several workers. The review of literature shows that depth of water, phase wise measuring, optimum stocking density, regular production of natural fish food organisms, planned pond management strategies can help toset a production target of average 3 – 3.5 tons/ha/year. Use of supplementary feed with different species combinations as per market demand for deriving maximum production and profitability is an important culture criteria for the rural farmers. The present case study of demonstrative modes in Gram Vikash was an extension of technology for multiple stocking and multiple harvesting aiming at continuous production of consumable fish throughout the year. The implementing agencies Gram Vikash aims to demonstrate this model to the adopted villages for incorporating the same in village community ponds by women self helpgroups.

The majority of rural women in India as well as in other developing countries actively participating farm related operations besides fulfilling their responsibilities as homemakers and the extent of their participants however vary depending upon the socio-economic and cultural background of thearea. One of the pre-requisites to promote empowerment of women is the promotion of organizations among women. Women cab be organized through formation of co- operatives, MahilaMandals, Self Help Group (SHG) etc.

The study reveals that there is a no. of vocational avenues in fisheries by which the talents of women can be empowered through production oriented programes. Capa city building and improving their ability and efficiency by way of education and training in proper manner will instinct confidence amongst them. This will equip them to play a commendable role in the vast fisheries sector effectively. Self development and leadership qualities acquired through resourceful experience will emancipate them from the clutches of poverty and ignorance. In the prospects of an ever growing chance of employment, it is easy to transform fishermen folk as earning members contributing very much to the enhanced production and welfare. No doubt the security of life and economic and social will being attainable and will help promote the quality of lives of coastal fisherwomen folk speeding the process of rural upliftment.

SUMMARY AND CONCLUSION

Of the different global food production systems, aquaculture is widely perceived as an important weapon in the global fight against malnutrition and poverty,

Particularly within developing countries like India. Aquaculture is regarded as an important domestic provider of much needed high-quality animal protein and other essential nutrients and a provider of employment opportunities and cash income. In view of these positive characteristics, it is perhaps not surprising that aquaculture has came out as the world's fastest – growing food production sector for nearly two decades.

Rural aquaculture is now developed as an entrepreneurial activity that is financially viable, even for small-scale

operations. Aquaculture has a positive role in rural development, both in coastal and inland situations. The contribution of marine aquaculture to employment and reduced rural migration has been noted in a number of countries for example, Norway, United Kingdom and Greece, particularly in several rural areas where few alternative economic activities have been able to provide stable, long-term jobs.

The aquaculture scenario is dominated by candidate species like carps and shrimps particularly in our country. This is because our country is situated geographically in tropical environment and as such temperature plays an important role for carp and shrimp culture. Carps and other cyprinids contribute the largest share in the total global aquaculture production. As carps are the main stay of aquaculture in India; so India is called "carp country" with particular reference to aquaculture. Last three decades have witnessed a

phenomenal growth in the farming (like extensive, modified extensive and intensive) of carps in India as a result the market demand of fry for stocking also has increased. Easy accessibility to seed a consumer preference is also more in case of carps. Shrimp has more export potential in our country and our environment and geo-graphical climate is conducive for culture ofshrimp.

The case study after the comprehensive review has come across several issues and probable solutions which can address the rural community fish culture scenario. The following suggestions given by different workers are proposed for implementation by any agency aiming at social development involving rural communities. In line with the Rome declaration on world food security and the world food summit plan of action and following the recommendations of Kent (1995), if aquaculture is to play a greater role in improving food security and the alleviation of poverty, it is recommended that-

- The actual and unfulfilled potential of aquaculture to contribute to food security and poverty alleviation should fully be documented (Peter Edwards, 1999; Manfuzuddin Ahmed, 1999).
- Funding for aquaculture for the poor should be increased, especially with in those fish-eatingcountries where traditional aquaculture practices already exist (Edwards, 1999; Kent, 1995).
- Aquaculture projects should not interfare with the food supplies of the poor (Kent, 1995).
- Existing aquaculture activities of the poor should be strengthened through the use of improved farming / extension approaches (Ahmed and Loirca, 1999).
- Investment need to be encouraged in building the institutional capacity and knowledge base concerning sustainable aquaculture practices to manage the sector (Tacon and Barg, 2001).
- The focus should be on low cost products favoured by the poor (Kent, 1995) and there is a growing school of thought that if aquaculture is to significantly contribute to increase income of poor farmers, that they should not just be restricted to low-value species (Yap, 2001).
- Emphasis need to be placed on improving culture systems for aquatic species placed nearer to producer the food chain (Tacon and Barg, 1998).
- Production should be for local consumers (Kent, 1995).
- Community production should be encouraged (Kent, 1995).
- The consumption of aquaculture products from a human nutrition viewpoint should be encouraged and promoted
- Food security impacts should be monitored (Ahmed and Lorica, 1999; Kent, 1995).

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