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An Economic Assessment of Fish and Prawn Health Management in Andhra Pradesh§

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Abstract

The assessment of physical and financial losses due to incidence of diseases in aquaculture is essential to strengthen the socio-economic status of fish farmers. This study has been conducted in four districts (Nellore, West Godavari, East Godavari, and Prakasham) of Andhra Pradesh which ranks first in the production of freshwater prawn and second in freshwater fish in India. The study is based on a survey of 120 fish farmers who owned small (< 5 acres), medium (5-10 acres) and large (>10 acres) culture ponds. The study has elicited the geographic profile of fish farmers, aqua inputs, fish and prawn diseases, health management costs, and physical and financial losses in carp and prawn production systems in Andhra Pradesh. The study has revealed that health management costs are higher in prawn than those in carps production systems. The physical and financial losses were higher in prawn than carps culture systems. The study has made suggestions to minimize health management costs and losses in aquaculture in Andhra Pradesh.

Key words: Fish farmers, aquaculture, economic loss, health management, fish diseases, prawn diseases, Andhra Pradesh

JEL Classification: Q22, J1, O13

Introduction

In India, the fish production has been recorded 7.6 million tonnes comprising 4.1 Mt capture fisheries and 3.5 Mt aquaculture production (FAO, 2008). The freshwater aquaculture in India is carp-oriented. The joint share of three Indian major carps and three exotic carps in freshwater aquaculture production is over 90 per cent (Katiha and Bhatta, 2002). Andhra Pradesh ranks first in freshwater prawn and brackishwater shrimp production and second in freshwater fish production (DoF, 2009). Three major carp species, viz. *Catla catla*, *Labeo rohita* and *Cirrhinus mrigala*, are farmed in the polyculture systems in this state (Veerina *et al.,* 1993). The farmers in Andhra Pradesh initially sought the standard yield-maximizing carp culture technology such as stocking of a combination of the three Indian major carps (*Labeo rohita*, *Catla catla* and mrigal) together with three Chinese carp, namely silver carp, grass carp and common carp (Jhingran, 1991). However, due to less demand or low price of exotic Chinese carps in the market, farmers in Andhra Pradesh shifted to a two- or three-species composite culture of *Catla catla*, *Labeo rohita* and *Cirrhinus mrigala*. Nearly 75 per cent of the farmers follows a two-species system comprising *Catla catla* and *Labeo rohita*. The average gross yield for this two-species is 5,890 kg/ha/year. The mean stocking density is around 2900 stunted fingerlings per hectare. The ponds are heavily fertilized with organic manure (19,000 kg/ha/year) and inorganic fertilizers (2300 kg/ha/year) (Veerina *et al.,* 1993).

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Aquaculture has been an important sector in the introduction, transfer and spread of aquatic diseases in the fisheries. The introduction of exotic pathogens along with newly introduced aquatic animals has too often resulted in severe socio-economic and ecological impacts (Klinger and Floyd, 2002). However, good hatchery management practices, including rigorous screening of brood stock for pathogens and routine diagnostics and treatment of fry and fingerlings, will do much to reduce the possibilities of stocking unhealthy seed and the spread of disease into new areas (Arthur and Subasinghe, 2002). Losses of more than ₹70 million due to disease-induced mortality and impaired growth are incurred annually in Andhra Pradesh. Ectoparasitic diseases account for 70 per cent of the problems, while bacterial and fungal diseases account for 27.5 per cent and 2.5 per cent problems, respectively (Rao *et al*., 1992). Fungal infections are common among many fish species and can prove fatal if not treated early. Incidence of white spot viral disease had caused high mortalities and severe damage to the shrimp culture industry in Indonesia and India (Hatai, 1994; Anon, 1994). Epizootic ulcerative syndrome of fish and white spot disease of cultured shrimp have sufficiently demonstrated the economic impacts of aquatic animal diseases on aquaculture. A global estimate of disease losses in aquaculture by the World Bank in 1997 was of the order of US$ 3 billion per annum. The major health problems were identified in carp farming but were not able to quantify either health-related losses or the health management costs incurred by the farmers (Subasinghe, 2001; Mohan and Bhatta, 2002).

The high risk of disease transmission and parasite infestations among species has increased the level of uncertainty which the farm managers have to contend to develop the industry (Pozio and Rosa, 2005). Scarfe *et al.* (2005) have observed that aquaculture bio-security programs addressing the aquatic animal pathogens and diseases have become an important focus for the aquaculture industry. Most of the farmers are aware about the consequences of diseases on growth, survival and final production, but only a small percentage is able to identify the problems and quantify disease-related losses. The majority of farmers depends on friends, consultants, sales persons or pharmacists for advice on diagnosis and medication. The advice of feed and chemical sales persons is likely to be biased with their marketing interests (Mohan and Bhatta, 2002; MacRae *et al*., 2002). Hence, assessment of the economic impact of disease in aquaculture is vital to develop farmer-oriented primary fish health management packages and in determining the optimal investment for fish disease control (Faruk *et al*., 2004). Under this backdrop, the present study was conducted through a survey to quantify the extent of physical and economic losses due to fish disease in some selected districts of Andhra Pradesh.

Methodology

The present study was conducted in the four districts, viz. Nellore, West Godavari, East Godavari and Prakasham, of Andhra Pradesh during March to April 2011. These four districts were selected based on their significant contribution to the total state fish production. Due to lack of secondary data on the sizes of aquaculture ponds, the fish ponds were categorized into three groups, viz. small (< 5 acres), medium (5-10 acres) and large (> 10 acres) ponds. Stratified random sampling procedure was adopted for the selection of districts and fish farmers. A sample of 120 farmers was selected from the four districts [Nellore (20), West Godavari (40), East Godavari (40) and Prakasham (20)] in Andhra Pradesh. The primary data were collected by survey method with the help of pre-tested schedules through personal interview. The data were analysed using frequency and descriptive statistical techniques.

Results and Discussion

To identify the problems of fish farmers, data were collected on their geographic profile. It was observed that aquaculture ponds were located nearer to the main roads (5 km) and main rivers (4 km) in the East Godavari district compared to other districts. The distance between village marketers and farmer ponds was less (2.4 km) in the West Godavari district. The distance of fish seed source varied between 37 km and 221 km, indicating high transportation cost for farmers (Table 1). Most of the fish and prawn seed requirements of the farmers were met by the private hatcheries (49%) and middlemen (46%), whereas the role of government hatcheries was low (5%). The private hatcheries (93%) were meeting most of the fish seed requirement in the East Godavari district and the majority of Nellore farmers were procuring fish seed through middlemen (85%).

Table 1. Geographic profile of fish farmers in selected districts of Andhra Pradesh, 2011

District	Average distance (km) of farms from						Seed suppliers (%)		
	District headquarters	Main road	Main river	Fish market	Home	Fish seed source	Private hatchery	Govt. hatchery	Middlemen
Nellore	16.6	15.8	6.5	15.8	2.3	206	10	5	85
West Godavari	12.8	11.2	10.7	2.4	0.5	37	48	7	45
East Godavari	40.0	5.0	4.0	5.0	3.0	45	93	2	5
Prakasham	17.0	16.4	6.2	15.5	1.0	221	45	5	50

Table 2. Characteristics of aquaculture ponds in selected districts of Andhra Pradesh

District	Average experience of fish culture (years)		Culture period (months)		Average production (tonne/acre)	
	Fish	Prawn	Fish	Prawn	Fish	Prawn
Nellore	36	9	9	6	3.51	0.55
West Godavari	10	7	8	7	3.75	0.61
East Godavari	7	11	8	7	2.50	0.67
Prakasham	4	3	8	7	3.85	0.52

The average fish culture experience of farmers was longest in the Nellore district (36 years). The overall average culture period was 14 months for fish and 8 months for prawn. The fish production varied across the districts and was highest in Prakasham (3.85 t/acre) and lowest in East Godavari (2.50 t/acre). The prawn production was highest in East Godavari (0.67 t/acre) and lowest in Prakasham (0.52 tonnes/acre) districts (Table 2).

The classification of aquaculture ponds into small, medium and large ponds revealed that more than 50 per cent famers were holding large ponds (> 10 acres), followed by medium (28%) and small (18%) ponds (Table 3). The majority of farmers were holding medium-size culture ponds in the West Godavari district and large-size ponds in the East Godavari (22) district.

Across districts, the polyculture practice was more prevalent (66 No.) with species combination of *Rohu* and Mrigal whereas *Letopenaeus vannamei* and *Penaeus monodon* were the dominant species under monoculture practices. The average water depth maintained was 1.60-1.95 m in monoculture and 1.77-2.13 m in polyculture systems. The average stocking density of prawn was 1,23,000/ha under monoculture system and 5000/ha under polyculture system. The advanced fingerlings of *Rohu* and Mrigal were being used under polyculture systems with mean weight of 90-170 grams. The price of advanced fish fingerlings was ₹400-650 /1000 and of prawn seed was ₹300-540 /1000 (Table 4).

Table 3. Classification of aquaculture ponds in selected districts of Andhra Pradesh

District	Small (< 5 acre)	Medium (5-10 acre)	Large (>10 acre)
Nellore	1	3	16
West Godavari	7	17	16
East Godavari	9	9	22
Prakasham	1	5	14
All	18 (15)	34 (28)	68 (57)

**Note:* Figures within the parentheses are percentage to total

The inputs used for carp culture ponds in the selected districts of Andhra Pradesh mentioned in Table 5, reveal variation in their application. The use of poultry manure was highest (5.12 t/acre) in the Nellore district, while in the remaining areas it was about 2 t/acre only. The rice bran was not used in the West Godavari district, while groundnut oil cake and fertilizers were not used in the East Godavari district.

Table 4. Pond management in selected districts of Andhra Pradesh

Particulars	Monoculture	Polyculture
Fish farmers (No.)	54	66
Depth (m)	1.60-1.95	1.77-2.13
Species	*Letopenaeus vannamei* *Penaeus monodon*	Rohu, Mrigala
Seed stage	pl 7 - pl 21	Advanced fingerlings
Stocking density (per ha)	123000	5000
Size (mm)	5	-
Weight (g)	-	90-170
Price/1000 No. (₹)	300-540	400-650

Table 5. Inputs used for carp culture in selected districts of Andhra Pradesh

Input/acre	Nellore	West Godavari	East Godavari	Prakasham
Poultry manure (tonne)	5.12	2.3	2.3	2.0
Cow dung (tonne)	0.86	0.61	4.1	1.0
Rice bran (kg)	85	-	250	200
Groundnut oil cake (kg)	37	300	-	40
Fertilizers (kg)	133	355	-	125
Labour (No.)	1	1	2	1
Pesticides (g)	481	316	450	425
Lime (kg)	187	210	200	100
Drugs (g)	105	191	53	209

Table 6. Inputs used for prawn culture in selected districts of Andhra Pradesh

Input/acre	Nellore	West Godavari	East Godavari	Prakasham
Poultry manure (tonne)	2	5	-	4
Cow dung (tonne)	1.25	0.5	-	1.25
Rice bran (kg)	90	90	150	91
Groundnut oil cake (kg)	-	35	-	40
Commercial feed (kg)	-	50	50	30
Fertilizer (kg)	175	225	630	231
Labour (No.)	1	1	3	1
Pesticides (g)	20	342	836	290
Lime (kg)	150	168	465	170
Drugs (g)	200	275	210	178

The application of fertilizers was highest in West Godavari (355 kg/acre) and lowest in Prakasham (125 kg/acre) district. The application of drugs was highest in Prakasham (209 g/acre) and lowest in East Godavari (53 g/acre) district.

The application of inputs for prawn culture also differed across the study districts (Table 6). The application of poultry manure was highest in West Godavari (5 t/acre) and lowest in Nellore (2 t/acre). Poultry manure, cow dung and groundnut oil cake were not used in East Godavari, while commercial feed and groundnut oil cake were not used in Nellore district. In contrast to carp culture, prawn farmers were using commercial feeds of popular brands such as C.P., Nasa

Table 7. Species-wise fish and prawn diseases recorded across different districts of Andhra Pradesh

Disease	Species	No. of ponds				Overall	
		Nellore	West Godavari	East Godavari	Prakasham	No.	Per cent
Argulus	Indian Major Carps	12	14	6	4	36	19.4
Black gill Argus	*Catla catla, Labeo rohita*	2	7	14	2	25	13.4
Columnaris	*Catla catla, Labeo rohita*	5	15	2	3	25	13.4
Dactylogyrus	*Catla catla, Labeo rohita*	-	3	-	-	3	1.6
Cotton wool	*Catla catla*	1	-	-	1	2	1.1
Dropsy	*Indian Major Carps*	-	15	1	2	18	9.7
Gas bubble	*Indian Major Carps*	2	6	-	2	10	5.4
Gill fluke	*Catla catla*	2	14	12	8	36	19.4
Gill rot	*Catla catla, Labeo rohita*	1	-	-	1	2	1.1
Lernea infection	*Catla catla*	-	2	-	-	2	1.1
Red disease	*Pangasius, Catla catla*	8	12	3	4	27	14.5
Total		34	91	66	35	186	100

Table 8. Dosage and cost on pesticides used in different districts of Andhra Pradesh

Pesticide/acre	Nellore		West Godavari		East Godavari		Prakasham	
	Dosage (L)	Cost (₹/L)	Dosage (L)	Cost (₹/L)	Dosage (L)	Cost (₹/L)	Dosage (L)	Cost (₹/L)
Butox	0.75	700	0.7	800	0.75	850	0.75	750
Cypermethane	-	-	0.1	420	-	-	0.1	420
Cypermethrin	-	-	0.1	420	-	-	-	-
Deltaxplus	-	-	0.05	35	-	-	0.05	35
Desis	-	-	-	-	1	350	-	-
Ecolax	0.1	400	0.1	400	0.1	400	0.1	400
Ecoloa	0.1	100	-	-	-	-	0.1	100
Eucalex	-	-	100	1750	-	-	-	-
Nuvan	0.25	500	0.25	500	0.25	500	0.25	500

and Avanthi. The average usage of pesticides was highest in East Godavari (836 g/acre) and lowest in Nellore (20 g/acre).

According to the respondent-farmers, 19 per cent culture ponds were infected with Argulus and gill fluke in Indian major carps (IMC) and 13 per cent culture ponds were infected with black gill and columnaris in *Catla Catla* and *Labeo rohita* across the selected districts. Comparatively, Argulus and red disease was high in IMC and Pangassius in the Nellore region. About 41 per cent culture ponds were found infected with black gill, columnaris and red disease in *Catla catla*, *Labeo rohita* and Pangassius in all the four districts of Andhra Pradesh (Table 7).

The pesticides were used for managing diseases in the culture systems. The application of pesticides to the culture systems in terms of both quantity and cost was highest in the West Godavari district and lowest in the Nellore district. Some pesticides such as butox, nuvan and ecolax were commonly used across all the study districts, whereas cypermethane, cypermethrine and eucalex were used only in the West Godavari district (Table 8).

The cost on average drugs was highest in the Prakasham district, followed by the East Godavari, West Godavari, Prakasham and Nellore districts. As per respondent-farmers, these drugs were being applied as per the suggestions of the veterinarians.

Table 9. Disease-wise drugs used in the selected districts of Andhra Pradesh

Diseases	Drugs/acre	Nellore		West Godavari		East Godavari		Prakasham	
		Dosage	Cost	Dosage	Cost	Dosage	Cost	Dosage	Cost
Argulus	Desis (mL)	-	-	0.5	300	-	-	-	-
	H-tech powder (g)	0.01	40	0.01	37	0.04	140	0.01	37
	Nuvan (mL)	-	-	0.5	300	-	-	-	-
Argulus, Lernea	Parachire powder (g)	-	-	-	-	0.01	350	0.01	350
Black gills	Acriflavia (g)	0.5	100	-	-	-	-	0.05	100
	Acriflavin (g)	-	-	0.05	70	0.05	700	0.05	70
	Ecotoxin (g)	-	-	0.4	690	0.4	690	0.2	690
	Zeolite (kg)	-	-	-	-	0.01	600	-	-
	Hydrogen peroxide (L)	-	-	0.01	250	-	-	-	-
Columnaris	Deltax (mL)	0.5	750	0.05	375	0.05	750	0.05	750
	Deltaplus (mL)	-	-	0.05	375	-	-	-	-
	Sulfamethazin (g)	-	-	0.1	1000	0.1	1000	0.1	1000
Fungal diseases	Teflon (mL)	0.2	700	0.25	800	0.2	800	0.25	4000
	Zithamin (L)	-	-	-	-	0.5	1150	0.5	1150
Gill fluke	Albadazone (g)	0.5	800	0.05	800	0.5	1600	0.5	800
	Delta methaion (g)	-	-	0.05	225	-	-	-	-
	Deltamethrin (g)	-	-	0.05	450	1	750	-	-
Red disease	Enrofloxcin (mL)	0.05	150	-	-	0.02	22	0.05	150
	Enrotoxin (g)	0.05	35	-	-	-	-	0.05	35
Average		0.26	367.85	0.16	436	0.24	713	0.15	761

Table 10. Production costs for carp and prawn culture in selected districts of Andhra Pradesh

Production costs (₹/acre)	Carps		Prawn	
	Total	Per cent	Total	Per cent
Input costs	9180	15	6757	5
Labour costs	5738	9	5718	4
Farm-specific costs	46371	73	112115	88
Health management costs	1892	3	3136	3
Total	63,181	100	1,27,726	100

The production costs for carp and prawn culture were estimated separately in all the study districts of Andhra Pradesh. The average total cost (₹/crop/acre) was 63,181 for carp culture and 1,27,726 for prawn culture in these districts. The farm-specific costs included charges for electricity, irrigation and rent for equipment. The share of farm-specific costs in the total production cost was very high for both carps (73%) and prawn (88%) culture. The health management costs included expenditures on drugs, pesticides and lime and were comparatively high for the prawn culture. The average input costs (₹/crop/acre) were ₹ 9,180 for carp culture and ₹ 6,757 for prawn culture (Table 10).

The total cultivable area in all the districts with carp and prawn diseases was 1138 acres and 566 acres, respectively, in which the disease-affected area was more in prawn culture (67%) then carp culture (43%) in all the surveyed districts. The percentage of physical losses per acre due to carp disease was 3.20 and 11.40 in prawn culture. The fish and prawn losses due to environmental factors were found to be 1.2 per cent for carp culture and 5.4 per cent for prawn culture. As

Table 11. Estimated total losses due to fish and prawn diseases in the study districts of Andhra Pradesh

Particulars	Carps	Prawn
Culture area (acre)	1138	566
Disease affected area (% /acre)	43.0	67.0
Disease loss (%/acre)	2.0	6.0
Loss due to environmental factors (% /acre)	1.2	5.4
Total physical loss (%/acre)	3.20	11.40
Total quantity loss (kg/acre)	109	67
Average market price (₹/kg)	57	280
Total financial loss (₹/acre)	6202	18844
Health management costs (₹/acre)	1892	3136
Total loss (₹/acre)	8094	21980

per the respondent-farmers, the major environmental factors responsible for fish and prawn losses included low dissolved oxygen, high temperature, algae, turbidity and floods. In physical terms, the losses were found to be 109 kg/acre (3.2%) in carps and 67 kg/acre (11.4%) in prawn culture. Though the loss in terms of quantity was less in the prawn culture, value-wise it was high because of its high farm gate price (₹ 280/kg). The total financial loss was estimated to be ₹ 6202/acre in carp culture and ₹ 18,844/acre in prawn culture. On including health management costs, the average total loss was computed to be of ₹ 8094/acre in carp culture and ₹ 21,980/acre in prawn culture in all the four districts of Andhra Pradesh (Table 11).

Conclusions

The study has found that impact of fish and prawn diseases on aquaculture is quite significant. Argulus and gill fluke in the cultured fish and black gill and fungal disease in the cultured prawn have demonstrated significant negative socio-economic impact on aquaculturists in the state of Andhra Pradesh. The economic losses have increased as aquaculture has expanded and intensified. The heavy application of inputs to culture ponds has deteriorated the water quality and soil health. Due to lack of fisheries professionals for prescription of drugs, the fish farmers are using high doses of pesticides and other drugs which increases the cost on health management. The occurrence of diseases was higher in prawn than in carp culture. The losses have been found high due to disease than due to environmental factors. The total losses have been found to be higher due to prawn diseases than carp diseases. Therefore, there is a need for educating farmers on better management practices for carp and prawn culture systems in the country.

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