



## Community participated management of *chaur* (floodplain) fisheries: A case study of mahisar *chaur* in Samastipur district of Bihar, India

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Received: January 22, 2015; Revised received: July 20, 2015; Accepted: December 2, 2015

**Abstract:** Mahisar *chaur*, situated in north-eastern part of Samastipur district of Bihar, is spread over 607.29 ha area with an average water depth of 2.5-3 m. The *chaur* was flood prone and remained inundated with water for most part of the year and hence was not suitable for agriculture. With collective efforts of land owners, a drainage canal along with sluice gate was constructed to manage the flow of water in the *chaur* to take up both the agriculture and fishery enterprises in the *chaur*. Now the *chaur* is being successfully utilized for fishery by a cooperative society of land owners during the period of water logging (June/July to October) and for agriculture, by individual farmers during November to April. The present study investigated into income and employment generation and management practices of *chaur* (floodplain) in Samastipur (Bihar), India for suggesting suitable measures to improve production and productivity from the resource. For the purpose, primary data was collected from 60 sample respondent by personal interview method with the help of pre-tested questionnaire specially designed for the study. Fishery and agriculture was the two enterprises undertaken by land owners in the *chaur*. During rainy season when entire *chaur* is inundated with water fisheries is practised with community participation while agriculture is practiced during *rabi* season by individual farmers on their land holdings. Cropping intensity in *chaur* was 199.05 percent which indicate about two time use of same area for different economic activity. The overall net income from both the agriculture and fishery in *chaur* was INR 43,041.94 (US\$ 791.08) per hectare per annum and employment generation was 78.11 man days per hectare per annum. The contribution of agriculture in total income was 69.52 percent while that of fisheries was 30.48 percent. Retention of water in central part of the *chaur* for rearing of juveniles caught during draining out of *chaur* may improve fish productivity which in turn may increase income and employment opportunity and share of fisheries in total income.

**Keywords:** Community, Floodplain, Management of *Chaur*, Pre- harvest contractor

### INTRODUCTION

*Chaur*s (floodplains) are shallow transitional land, highly productive for both agriculture and fishery (Islam, 2003). Floodplains locally known as *chaur*s in Bihar, India, are major fisheries resources and measure about 45,978 ha, mainly found in the basins of Kosi-Gandak river systems of North Bihar (Govt. of Bihar, 2008). However, despite such natural resources and fish as highly preferred food item, aquaculture and open water fisheries resource remain highly underutilized (Govt. of India, 2008). The river Gandak and Koshi (along with its tributaries) have the distinction of nurturing huge number of seasonal common property water resources (*chaur*s). The Mahisar *chaur*, situated in north-eastern part of Samastipur district, is spread over 607.29 ha area with an average depth of 2.5-3 m. This is being utilised collectively by land owners for fishery and individually for crop cultivation. The *chaur* is owned by more than 1000 farmers of four villages namely Bhiraha east, Bhiraha west, Bhiraha south and Haripur who have their land holdings in the *chaur*.

The *chaur* is a pan shaped flood plain in the vicinity of Kareh river, a tributary to Koshi river. Before 1936, the *chaur* was getting inundated with water during June/July to September with 2.5 - 3.0 m of water and 0.8 - 1.0 m of water during September to January every year. Due to which, it was not possible to take up any agricultural crop in the *chaur* area. This water logging in the *chaur* rendered land owners of the *chaur* practically landless which also affected the labourers of the area badly as they were not getting work for earning their subsistence. Visualizing the gravity of situation, Indian Government constructed a bund across entire length of the Kareh river in 1930s. Sluice gates were also installed at several places to drain out the runoff water from upland to avoid unwanted water logging. However, the situation of the *chaur* remained the same. An innovative farmer of the village took initiative to organise the farmers, mainly youths, of the villages of the *chaur* area into a co-operative known as *Yuvak sangh* in 1936 for the construction of drainage canal (*Surhula baha*) to regulate the flow of water into *chaur* utilizing the sluice gate. The regulation of flow of water into *chaur* area allowed farmers to take up

agricultural crops individually on their land during *rabi* season and fishery in the *chaur* collectively during rainy season (*khariif* season). All the farmers, on whose lands channel was constructed donated their land to the *Yuvak sangh*.

Since construction of the drainage channel, the *chaur* is getting drained successfully every year on time to enable farmers to grow *rabi* crops in their respective lands and harvest bumper yield. The main crop of the *chaur* is wheat which is grown in over more than 85.82% area. Other crops grown in the *chaur* are gram, lentil and sugarcane. The fishes of the *chaur* are sold by the *sangh* to pre-harvest contractor in an open auction who is bound to drain the *chaur* in October month of the year. The income generated is used for the restoration of the drainage channel and for the welfare of the villagers of all the four villages. The *chaur* is being utilized for both the agriculture and fishery purposes that provide income and employment to farmers, fishers and daily wage earners.

The floodplains/wetlands need to be institutionalized by establishing controlling and management institutions (Marothia, 2002). But, due to fluctuating nature of fisheries resources and being extreme prone to floods, it is a challenging task. The research across the globe suggests the community participation in management and community-based institutions had succeeded in such situations (Hanna, 1998). Therefore, the efforts should be made to establish community based institutions and management system for sustainable utilizations of *chaurs*. Since, the *chaur* is being successfully utilised for the fishery through community as well as agriculture through individual farmers since long, it is imperative to study the model for further advocacy. Therefore, the present study is an attempt to investigate into economics and management of Mahisar *chaur*. The findings of the study will help in taking appropriate decision for the development of *chaur* in the state of Bihar.

## MATERIALS AND METHODS

The primary data for the study was collected from selected sample respondents by personal interview method with the help of pre-tested questionnaire specially designed for the study. The sample farmers/fishers for the study were selected following the multi-stage stratified random sampling technique in all the

**Table 1.** Cropping pattern on sample farms in Mahisar *chaur*.

Particulars	Area (ha)	Percentage to net sown area (%)
Wheat	98.27	85.01
Mustard	11.13	9.63
Others	5.11	4.42
Fisheries	115.6	100.00
Cropped Area	230.11	199.06
Net Sown Area	115.6	100.00
Cropping intensity (%)	199.057	

four villages using methodology describe in Cochran (1977). For the purpose of estimating income and employment generation and understanding the management of *chaur*, discussion with Farmers, District Fisheries Officer, Fisheries Extension Officer, president, secretary and member of the *yuvak sangh* was conducted. A total of 60 respondents were selected, comprising of 29 farmers, 10 artisanal fishers, 1 pre-harvest contractor, 12 members of *yuvak sangh* and 8 officials of Department of fisheries, Government of Bihar during 2012-13.

Cost and return for *chaur* fishery and various agricultural crops like wheat, mustard, gram, and sugarcane were estimated and compared following the method described by Salim and Biradar (2001). To evaluate economic feasibility of agricultural crops and fishery, benefit-cost ratio (BCR) was computed as per Gittinger (1982). With a purpose to compare income and employment generated from agriculture and fishery, income and employment generated in all the agricultural crops were averaged and multiplied with the cropping intensity to get income and employment generated per hectare. The average income and employment from fishery was estimated by dividing the total production from capture fishery with the entire area of the *chaur* to get the average income and employment per hectare from *chaur* area.

## RESULTS AND DISCUSSION

Cropping pattern affects cost and profitability of the farm and varies from farm to farm and place to place. The cropping pattern prevalent on sample farms was estimated and presented in Table 1. The cropping intensity on sample farm was 199.1 per cent. The moderate cropping intensity in the *chaur* indicates that the area under *chaurs* are being used during both the *rabi* season for agriculture and *Khariif* season for fisheries. Wheat was the major crop cultivated on 85.01 percent of cropped area followed by mustard (9.63%) and other like, Lentil, gram and sugarcane (4.42 %). Since agricultural crops and fishery were the economic activities being taken in *chaur*, economics of *chaur* depends on both the agriculture and fishery enterprises, and hence economics of both the enterprises have been estimated separately and presented in subsequent sections..

### Economics of agricultural crops produced in *chaur*:

The cost and return of all the agricultural crops were estimated and presented in Table 2. Perusal of the table revealed that wheat was the major crop of the *chaur*, which was cultivated on 85.8 per cent of the total *chaur* area. Net return from wheat cultivation was highest, INR 30,519 (US\$ 560.93) per hectare with a BCR of 1.81. The variable cost accounted for 62.2 per cent of total cost and rest 37.8 per cent was accounted by fixed cost. Among variable costs, cost of labour was largest component sharing for 36 percent of total variable cost followed by cost of fertilizers (31 per

**Table 2.** Cost and returns from various agricultural crops on sample farms.

Particulars	Wheat		Mustard		Others		Overall	
	(₹/ha)	(\$/ha)	(₹/ha)	(\$/ha)	(₹/ha)	(\$/ha)	(₹/ha)	(\$/ha)
A. Variable Cost								
Seed	2033.93	37.38	220.44	4.05	2530.33	46.51	1879.82	34.55
Fertilizer	7265.4	133.53	5597.48	102.88	2941.29	54.06	6910.32	127.01
Irrigation charges	1617.97	29.74	1208.93	22.22	1510.24	27.76	1573.41	28.92
Machine Hiring	3407.36	62.62	3227.76	59.32	809.79	14.88	3273.99	60.17
Labour Cost	8437.9	155.08	7648.29	140.57	11322.86	208.11	8489.89	156.04
Miscellaneous	581.75	10.69	544.03	10.00	859.1	15.79	590.46	10.85
Interest on working capital	198.19	3.64	157.36	2.89	225.45	4.14	195.44	3.59
Total Variable Cost	23542.5	432.69	18604.29	341.93	20199.06	371.24	22913.32	421.13
B. Fixed Cost		0.00		0.00		0.00		0.00
Depreciation	1056.71	19.42	1092.41	20.08	967.57	17.78	1056.2	19.41
Interest on fixed capital	958.02	17.61	1075.77	19.77	843.75	15.51	964.37	17.72
Repair & Maintenance	311.61	5.73	280.14	5.15	309.47	5.69	308.46	5.67
Land Rent	11965.19	219.91	12029.99	221.10	12020.55	220.93	11973.96	220.07
Total Fixed Cost	14291.53	262.67	14478.31	266.10	14141.34	259.91	14302.98	262.88
C. Total Cost	37834.03	695.36	33082.6	608.03	34340.4	631.15	37216.3	684.01
D. Revenue		0.00		0.00		0.00		0.00
Total production (kg)	4928.16	4928.16	1753.23	1753.23	2054.72	2054.72	4491.34	4491.34
Price (₹/kg)	13.87	0.25	34.34	0.63	28.67	0.53	14.95	0.27
Gross Income	68353.58	1256.29	60205.92	1106.54	58908.82	1082.70	67140.18	1233.99
E. Net Income	30519.55	560.93	27123.32	498.51	24568.42	451.55	29923.88	549.98
F. BCR	1.81	1.81	1.82	1.82	1.72	1.72	1.8	1.8

**Table 3.** Cost and return from fishery in Mahisar *chaur*.

Particulars	(Pre-Harvest Contractor)		Artisanal Fishers		Overall Fishery	
	(₹/ha)	(US\$/ha)	(₹/ha)	(US\$/ha)	(₹/ha)	(US\$/ha)
A. Variable Cost						
Labour Cost	1575.03	28.95	1321.44	24.29	2896.47	53.24
Miscellaneous	1419.4	26.09	667.51	12.27	2086.91	38.36
Interest on working capital	221.06	4.06	111.82	2.06	332.88	6.12
Total Variable Cost	3215.49	59.10	2100.77	38.61	5316.26	97.71
B. Fixed Cost						
Depreciation	329.17	6.05	1448.85	26.63	1778.02	32.68
Interest on fixed capital	287.38	5.28	1175.73	21.61	1463.11	26.89
Land Rent	6092.64	111.98	0	0.00	6092.64	111.98
Repair & Maintenance	24.09	0.44	171.49	3.15	195.58	3.59
Total Fixed Cost	6733.28	123.75	2796.07	51.39	9529.36	175.14
C. Total Cost	9948.77	182.85	4896.84	90.00	14845.62	272.85
D. Revenue						
Total production (kg/ha)	164.93	3.03	78.88	1.45	243.81	4.48
Selling Price (₹/kg)	101.87	1.87	64.27	1.18	89.71	1.65
Gross Revenue	16801.42	308.80	5069.62	93.18	21871.04	401.97
E. Net Income	6852.65	125.95	172.77	3.18	7025.42	129.12
F. B:C Ratio	1.69	1.69	1.04	1.04	1.47	1.47

cent). Mustard was the second most popular crop cultivated in the *chaur*. Net return from the mustard cultivation was ₹27,123 (US\$ 498.51) per hectare and BCR 1.82. Variable cost constituted about 56 per cent of total cost and 44 percent was shared by fixed cost. Among variable cost, cost of labour was the major cost accounting for about 41 per cent of total variable cost followed by cost of manures and fertilizers (30 per cent). A number of other crops like lentil, gram and sugarcane were also being cultivated in the *chaur*. The average net return from other crops was ₹24,568 (US\$ 451.55) per hectare with BCR of 1.72. Overall net return from agricultural crops was ₹29,923 (US\$ 549.98) per hectare with a BCR 1.80. The variable cost was the major contributor of expenditure (61.5 per cent) out of which labour cost was the major contributor followed by cost on fertilizer and manures.

**Economics of *chaur* fishery:** Mahisar *chaur* is river-fed and inundate with water during flood season. In the *chaur*, capture fishery is in practice where fish and fish

seed enter into *chaur* from Kareh river through sluice gates while filling the *chaur* with river water during the month of June/July. By closing the sluice gate, managing committee ensure longer duration of stay of water to provide longer duration for fishes to grow and drains it out in October for growing *rabi* crops. Fishing remain unrestricted till the auction of *chaur* for all the artisanal fishers residing in the vicinity of the *chaur* by employing simple gears like gill net and traps without paying anything to land holders. However, after auction of *chaur* in month of August, pre-harvest contractor restrict the fishers from fishing. The *chaur* is harvested by the contractor with the help of fishers, while draining out the *chaur*. The *chaur* gets drained out in 25-30 days by the end of October and get dried up in next 10-15 days by mid of November. After drying up of *chaur*, farmers grow *rabi* crops in their respective land.

Cost and return for capture fishery for both kinds *i.e.*

**Table 4.** Employment generation from agriculture and fishery in the *chaurs*.

Enterprise	Family Labour	Hired Labour	Total Labour
Agriculture	4.65	55.19	59.84
Fishery	0.00	18.27	18.27
Overall	4.65	73.46	78.11

**Table 5.** Income distribution among the different stakeholders.

Stakeholders	Income (₹/ha)	Income (US\$/ha)	% Income
Farmers			
(a) Agriculture	29923.88	549.98	69.5
(b) Fisheries	6092.64	111.98	14.2
(c) Total	36016.52	661.96	83.68
2. Artisanal Fishers	172.77	3.18	0.4
3. Pre Harvest Contractor	6852.65	125.95	15.92
Total Income	43041.94	791.08	100

**Table 6.** Income and employment generation from the *chaur*.

Particulars	Agriculture	Fishery	Overall
Income (₹/ha)	29923.88	13118.06	43041.94
	(69.52)	(30.48)	(100.00)
Income (US\$/ha)	549.98	241.10	791.08
Employment (man days/ha)	59.84	18.27	78.11
	(76.61)	(23.39)	(100.00)

Note: Figures in parenthesis indicate percentage of respective figure to overall

before auction (artisanal fishers) and after auction (pre-harvest contractor) was estimated separately and presented in Table 3. The productivity of the *chaur* was 243.81 kilogram per hectare per year. Chandra *et al.* (2010) found average fish production of 2920.43 kilogram per hectare per year from *beels* of Bangladesh whereas production from the *chaurs* was 243.81 kilogram per hectare per year, indicates poor management of capture fishery in *chaurs* of Bihar in comparison to Bangladesh. It was also observed that the size of captured fishes were small, which indicates the existence of potential to increase the yield from *chaur* by extending the period of rearing of juvenile fishes. Since source of seed in *chaur* is only through river water, sufficient number of fish seed required to be stocked as suggested by Jha and Chandra (1997) to get optimum yield from the *chaur*.

The net average profitability of the pre-harvest contractor was ₹6,852.65 (US\$ 125.95) with BCR 1.69 whereas artisanal fishers were fishing with a nominal profit of ₹172.77 (US\$ 3.18) per hectare per year. The overall net income from the *chaur* fishery was ₹7025.42 (US\$ 129.12) with BCR 1.47. The Variable cost was 35.8 per cent of total cost which is contradictory to the estimate of Jha (2009), who estimated higher percentage of variable cost (54.5%) in the total cost of fish cultivation in flood prone area of Bihar. It may be mainly due to absence of seed stocking in case of Mahisar *chaur*. Labour cost was also very less as harvesting was done during draining out the *chaur* only. Fixed cost (64.2%) was the major component of

total cost out of which land rent was the major one.

**Income and employment generation from agriculture and fishery:** Agriculture and fishery both are labour intensive and generate ample employment opportunities. In the study area most of the agricultural and fishery activities were carried out on contract basis. To estimate employment of human labours in man days, contractual charges for labour work was divided by the minimum wage rate declared by government of Bihar for the Agricultural year 2012-13 and are presented in the Table 4. Labour absorption in agriculture (59.84 man days per hectare) was substantially higher than capture fishery (18.27 man days per hectare). The total employment generated from *chaur* area was 78.11 man days per hectare per annum out of which 94.05 per cent was for hired labour. Employment generation from fishery was very poor mainly due to the fact that in Mahisar *chaur*, fishery demands less managerial inputs resulting in farmers spending little of their time on management, supervision and making arrangements for fish harvesting.

Income distribution among different stakeholders namely farmers, artisanal fishers and pre-harvest contractor in Mahisar *chaur* are given in the Table 5. The share of farmers, artisanal fishers and pre-harvest contractor for *chaur* fisheries was 83.68 percent, 0.40 percent and 15.92 percent in total income generated from *chaur*. Income and employment generation vary from enterprise to enterprise. The net return from both the agriculture and fishery in *chaur* was ₹43,041.94 (US\$ 791.08) per hectare per year. The contribution of agriculture and fishery in *chaur* income were 69.52 per cent and 30.48 per cent respectively (Table 6). It is also clear that net return generated from agriculture was higher than fishery in the *chaur*. The overall employment generation in *chaur* from both the agriculture and fishery enterprise was 78.11 man days per hectare per year out of which about 76.6 percent was contributed by agriculture and only 23.4 percent was from fishery (Table 6). The share of fisheries in total income and employment may be improved by adopting improved package of practices suggested for the enhanced fisheries in such resource.

Thus both the agriculture and fishery component were playing important role in generating income and employment opportunities for different stakeholders depending on *chaurs* for their livelihood. Hence there is need to give due weightage to both the enterprises for optimal harnessing of potential of *chaur* in economic development of the region. It was observed that a large number of juveniles were also caught while fishing in the *chaur* which are of no use. The same can be reared in small portion of *chaur* for fish production from the resource. This will also improve the share of fisheries in total income and employment from the *chaur*.

**Community participated management of *chaur* fishery:** During the month of late June or early July either due to flood in the Kareh river or opening up

sluice gate on request of the *Yuvak sangh*, the *chaur* gets sufficient river water. The river water enters into the *chaur*. With many of the brood fish, fry, and fingerlings enter into the *chaur* as the shallow water area of *chaur* act as the breeding and feeding ground for them. As soon as, the water level of Kareh river starts declining the *sangh* request the irrigation department to close down the sluice gate. This ensures water retention for longer period in the *chaur* area. This not only enhances the productivity of the *chaur* but also clean up the land mass from weeds which ultimately decreases the cost of field preparation for agricultural crops. During the last week of September or first week of October the *sangh* again requests the irrigation department to open the sluice gate to drain out the water of *chaur*. Harvesting of fishes is done by installing 4 to 5 stagnant trawl net (locally known as *bore jal*).

The *sangh* sells fishes to pre-harvest contractor at lump sum amount through open auction. The auction amount for the *chaur* for the year 2012 was ₹37 lakhs (US\$68003.57). The pre-harvest contractor harvest the fish during September to October for 25-30 days while draining out the *chaur*. The *Yuvak sangh* which manages fishery in Mahisar *chaur* has three layers management structures:

i. Core committee/office bearer- The core committee is a 3 members committee elected by general body of the society to take up day to day decisions to run the *sangh* activities and maintain account of the *sangh* and arrange meetings, etc. The *sangh* is headed by president who is assisted by one secretary and a treasurer which forms core committee. The main function of the core committee is to take decisions whereas working committee is the active body of the society which facilitate the auction and help in decision making.

ii. Working committee- General body of the *sangh* elects 9 members for a period of 5 years as working committee to facilitate smooth functioning of the society. The decision of the *sangh* is taken once all the members of working committee agree for the same. In case of opposition even by a single member of the working committee, the decision cannot be taken.

iii. General body- Any member of the four villages irrespective of their caste and creed who attain 18 years of age can become member of general body by paying membership fee to the society.

In general, 2-4 GBM (General body meeting) are arranged in a year. Any additional need based meeting can also be organised by the working committee on short notice. The source of income for the *sangh* is the money received from auctioning of fish of Mahisar *chaur*. The income is primarily used for upkeep of the drainage channel (*Surula baha*) and the rest amount is spent on other social activities. The *sangh* has been taking up various activities for the welfare of society such as education, social, religious, sports, road construction, and health etc. The *sangh* is provides subsidies for water pump and tubewells for agriculture pur-

poses in the *chaur* area. The *sangh* has established a library in the village, contributed in construction of school, temple etc. During health hazard, causality or any epidemic, the *sangh* has contributed actively for free of cost drug distribution or financial help. The decisions to spend the amount are taken by the working committee only if all the members agree for the same.

**Conflicts:** Conflict exists when individuals who depend on each other express different views, interests, or goals and perceive their views as incompatible or oppositional. There exist a conflict between farmers and fishers for fishing rights in the *chaur*. Some portion of the canal, in river after sluice gate (towards river), is property of Government of Bihar. Fishing is practiced while draining out of the *chaur* in this government owned portion of canal. As per the Government of Bihar, 2006 the government water body should be leased out to fishers co-operative only. So, fishers demand for leasing out the canal to them whereas *Yuvak sangh* claim that fishes are being produced in *chaur* which is owned by farmers and hence they have the right on fishes of the *chaur* and harvesting those fishes even in government canal. For a period of 3 years during 2003-05, Government of Bihar had leased the government owned portion of canal to fishers co-operative. However, in 2006, the right was transferred to *Yuvak sangh* and now, the case is pending in court for decision and fishing right is with *Yuvak sangh, the farmer's cooperative*. Leasing of the canal by government to fishers will increase the cost of fishing as farmers of the *chaur* will be forced to harvest fish in the *chaur*, a very large area, and hence will increase inefficiency in fish production in the *chaur*. The conflict can be sorted out with understanding the problem in depth by government officials and helping both the parties in resolving their conflict. Co- Management of such resource where all the stakeholders in the properties including government play a role in the management of resource may go a long way in resolving the conflict as well as better utilisation of such resource. Noble (2000) has also suggested that co-management played an important role in fishery development and conflict management. Co-management is a process of management in which government shares power with resource users, with each given specific rights and responsibilities relating to information and decision-making.

## Conclusion

*Chaur*s have tremendous potential for development of capture, culture and culture-based fishery. The present study concluded importance of resource in economic life of human being and potential for income and employment generation through agriculture and fishery activities, it is imperative to harness its potential for the economic development of underdeveloped region of the country. On the basis of findings of the study, following can be suggested for the development of

chaur fishery in Bihar

Community participated management of Mahisar *chaur* is successful in utilising the *chaur* resource for both the agriculture and fisheries which has provided ample employment opportunities as well as income to land owners as well as land less fishers and wage earners and hence can be adopted in other areas for the utilisation of the vast resource available in form of *chaur*. Though the Mahisar *chaur* is being managed profitably, there is scope for further improvement in it by avoiding growth overfishing and rearing the caught juvenile up to table size fishes. While draining out of the *chaur*, water should be retained in the lower most part of the *chaur* for rearing of juvenile fishes caught during the harvest. If it is not then, there should be ban on fishing with fine meshed gears and traps to enable the juveniles to re-enter into the river for further growth which will add to fish productivity in the river.

### ACKNOWLEDGEMENTS

The authors are thankful to Dr. W.S. Lakra, Director, Central Institute of Fisheries Education (CIFE), Mumbai-61, India for constant encouragement and providing necessary facilities for the study.

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