NATURAL RESOURCES SYSTEMS PROGRAMME

PROJECT REPORT[1]

DFID Project Number

R7830 and R7839

Report Title

Utilisation of poorly utilised land and water resources through multiple uses - Experiences of RP channel V canal command.

Annex Bv of the Final Technical Report of projects R7830 and R7839.

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Organisation

Rothamsted Research and ICAR Research Complex for Eastern Region

Date

2005

NRSP Production System

High Potential

[1] This document is an output from projects funded by the UK Department for International Development (DFID) for the benefit of developing countries. The views expressed are not necessarily those of DFID.

Contents

Summary

Waterlogging is prevalent in the canal command areas as a result of excess runoff accumulation in low lying areas, seepage from canals, surplus outflows and inadequate drainage due to topography and other constraints. Poor utilization of such low lying and seasonally waterlogged areas was one of the major problems for low productivity in the RP Channel V of Sone Command in Patna. Efforts were made following a participatory approach to understand their problems and constraints, and their response to viable option (s) for productive utilization of such areas, focussing on resource poor farmers who own very small patch and/or landless. This working paper describes the multiple uses of such poorly utilized and seasonally waterlogged land and water resources through need based interventions such as rice-fish culture, fish culture in waterlogged area and use of abandoned small pits for productive utilization. These options have been successfully demonstrated as a part of the output 2 towards exploring options for better water use in the command area of RP Channel V. The poor farmers (landless or small holders) were encouraged to undertake aquacultural interventions with whatever resources (including very small pits) they have. Overwhelming response was generated among the farming communities. More than 20 farmers or SHGs have already approached the ICAR-RCER scientist for technical guidance to undertake aquaculture related interventions on their leased or owned lands. Reports are being received of adoption of such interventions in other areas (outside the project area) as a result of farmer-to-farmer communication without involvement of project team. This is an indicator for spread and adoption of the interventions.

1.0 Introduction

The project "Integrated management of land and water resources for enhancing productivity in Bihar and eastern Uttar Pradesh" (R7830) was implemented by ICAR Research Complex for eastern region (IRCER), Patna in collaboration with IACR-Rothamsted and IWMI, Colombo, Sril Lanka. The project was implemented in the irrigated lands of the lower Indo-Gangetic Plain in Bihar and eastern Uttar Pradesh (UP). The population of this region is predominantly rural with small land holdings (<2 ha), high population density (650 persons km^{-2}) and low literacy rate (38%). Agriculture, especially rice and wheat production, is the predominant occupation. However, productivity generally is far below the potential and agricultural growth is slow. Seasonal waterlogging was one of the major problems for low productivity.

Waterlogging in low lands is prevalent in most of the canal commands. Such problem arises mostly due to improper water management and flow regulation of the canal water and accumulation of overland runoff water with inappropriate drainage system. Ungated outlets on the distributary and minor, often result in surplus flow of water even when there is no water requirement in the outlet command. Such surplus water gets accumulated in the low lands and creates waterlogging. Such lands remain more or less unproductive for a large portion of a year or for full year. Economically and socially viable opportunities for drainage of such lands seldom exist for want of proper drainage outlets due to topographical limitations. There are incidences, that the farmers used to raise the field level using soil excavated from small pits excavated in other patch of land. This created congenial conditions for growing some crops on the raised fields, but the pits excavated so, remained more or less unutilized except little production from wild fishing. Pits were excavated for soil for house construction purposes and remained unutilized thereafter. As resource poor farmers own these lands, they are deprived of benefits from their lands and have to earn livelihood through agricultural or urban labour. Hence, to alleviate livelihood of such poor farmers, efforts were made to utilize such poorly utilized lands through multiple uses. The work on multiple uses of water discussed in this paper was undertaken in the RP Channel 5 of Sone Command in Patna, Bihar.

2.0 Description of Study area and extent of problem

The study was conducted in the command of RPC V ($25^{o}26'$ – $25^{o}27'30"$ N; $84^{o}52'25"$ – $84^{o}56'40"$ E, 60m above MSL), a distributary of Patna Main Canal under Sone Canal Systems (Fig. 1). The command is located in Vikram Block of Patna district, Bihar. The 5.8 km long distributary bifurcated at 5.1 km RD and Tegrila minor offtakes and extends up to 3.8 km up to village Tegrila. Hence, the total length of the distributary is around 9.5 km. It has CCA (culturable command area) of 2200 ha. As per normal schedule, the water is released in the distributary between 25th June to 25th October during kharif season, while 25th December to 25th March during rabi season. At lower sides of the command a drain exists, which carries runoff from a catchment extending several kilometers beyond the study area, as well as surplus canal flows. The water level in the drain rises up during monsoon season, engulfing lands surrounding it, sometimes more than 50 to 100 m on both sides of the canal. The water stagnation is artificially created by closing the gate on the drain (located within one km away from the end of Tagraila minor) to protect further aggravation by back flow due to rise in water level in the river Punpun which drains into Ganges.

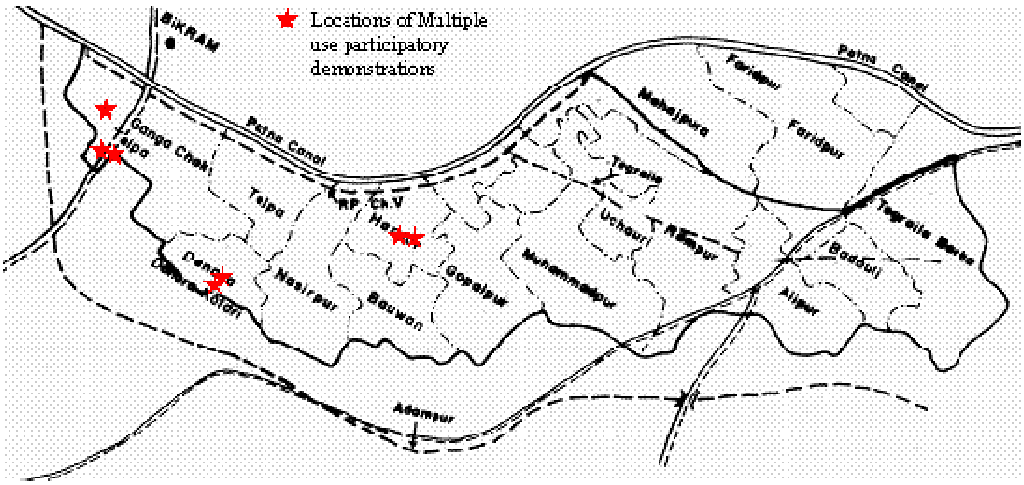


Fig. 1 Study area comprising of command of RP Channel 5 distributary and locations of participatory demonstrations carried out on multiple uses

The rainfall starts in the month of June and the runoff starts accumulating in the low lands by end of June. With release of water in the distributary and due to un-gated outlets, the surplus flow from the outlet commands also flows to low lands and accumulates there. The visible condition of waterlogging starts from the 2nd week of July and remains till late December, but in some pockets, it remains even upto February. In the command area of RP Channel 5, around 175 acres (5.1 % of CCA) remains waterlogged during monsoon season, while 52 acres (1.5% of CCA) remains un-utilised even during rabi season due to prolonged water stagnation, and these lands are mostly owned by resource poor farmers (Table 1). This area is land locked area which do not have direct connection with drainage way and suffers due to water stagnation. While there is much higher portion of the command that remains waterlogged along the drainage way due to water spreading by raised water level in drainage way and remains underutilized during kharif. Similarly the lands along the main canal in a strip of 50-100 m on both sides and along the distributary, remain waterlogged with poor yields due to canal seepage. Such lands are targeted in the study to enhance its productivity through multiple uses for productive utilization of such lands to improve livelihood.

Fig. 2. Drainage way along boundary of the area

Fig. 3. On-spot assessment of extent of waterlogging

Table 1. Waterlogged area under command of RPC 5

S.Nl.	Village	Kharif	Rabi
		Area (Acres)	
1	Danara + Aspura	30	6
2	Nisarpura	20	5
3	Baua +Harpura	25	8
4	Gopalpur	20	5
5	Mohammadpur	30	10
6	Rampur	20	8
7	Alipur	15	5
8	Baidauli	15	5
	Total	**175**	**52**

3.0 Materials and Methods

Participatory methods were adopted to communicate technological options with their merits and demerits for its promotion to the affected communities in the command area.

3.1 Participatory process & response

The participatory process is described in detail in Annexure B. iii (**Sections (Dr. A. Upadhyaya) to be included**). Central to this process was the development of a communication strategy to raise awareness of community members of potential opportunities. Poor productivity of waterlogged lands became an important issue in the course of dialogue with the community, which is directly affecting the livelihood of the resource poor farmers who own very small patch of land (that too unproductive). Assessment of waterlogged areas based on discussions revealed that surface or sub-surface drainage is not a viable option for these areas which are away from the drainage way. This led to broadcasting the options for productive utilization of the poorly utilized lands to the communities. In order to enhance production potential number of possible strategies were identified. A 2 fold, folder (Fig. 4) was also prepared and distributed. The following techniques for multiple uses were broadcasted to the farmers, SHGs (mostly involving landless poor), and members of the WUAs.

(a) Front side (b) Back side

Fig. 4. Folder prepared on multiple uses as communication material

Fig. 5 Exposure visit of farmers to experiments

F:g. 6 Meeting with SHG volunteers at Danara

1. Rice-fish culture in irrigated areas (by raising bund height and creating ponding of at least 10 cm depth)
2. Rice-fish culture in waterlogged areas using pen culture
3. Fish culture in depressions under watelogging using pen culture
4. Fish culture in small abandoned pits
5. Integration of agriculture, horticulture and fisheries using secondary reservoirs.

As outlined in Annexure B iii **(Sections 3.2)**, the project team then responded to feedback on the ideas raised. A questionnaire was used for this purpose to collect their feedback and response in order to analyse their interest, preferences and suggestions. Feedback was obtained through CIRRUS Volunteers, SHG Members, focus groups etc. It generated a good response and enthusiasm among the community. The analysis of responses collected through questionnaire **(Annexure B iii Section 3.2.2.1)** has shown that maximum respondents (27%) opted for multiple uses for productive utilization of waterlogged areas for enhancing productivity of their water & land resources / utilization of abandoned lands. For all the interventions communicated to them, aquaculture was the central theme. Community members showed apprehension as past experiences with fishery was a failure in that area. In the past few farmers tried to grow fish in excavated ponds, but failed to get viable produce. After thorough discussion on this aspect, it was found that the fish production was failed due to

- ✓ Lack of knowledge on package of practices on the part of growers
- ✓ Non-availability of good quality fingerlings
- ✓ Poor fish production due to reasons such as poaching, bird damage, less/excess water level, improper feeding and fertilization of the ponds, etc.

Based on the above observations, necessary aquaculture techniques along with details were thoroughly discussed, and exposure visits to experimental and other on-going participatory works were organized (Fig.5). It motivated them a bit, but still doubts could not be cleared fully. Therefore, strategic field demonstrations were felt necessary to communicate the idea and convince the community.

F:g. 7 On-spot discussion with farmers

To identify location and beneficiary for the demonstrations, further dialogue involving volunteers of SHGs and CIRRUS (project partner) as well as direct interactions were held (Fig. 6). As a result, two SHGs and four individuals came forward to initiate the process of demonstrations in participatory mode. However, due to fragmented land holdings, small field sizes, and scattered location the concept of secondary reservoirs was not found directly relevant to the small and poor farmers, while the other interventions (1-4) were taken up with the interested SHGs or individual farmers. They agreed to undertake the interventions with their own resources with critical inputs (mostly fingerlings as quality fingerlings were not readily available) and technical support from the project team. The details of interventions with SHG or individuals involved are listed in Table 2 and location is illustrated on the map in Fig. 1. In all the interventions, six fish species viz. catla (*Catla catla*), rohu (*Labeo rohita*), Mrigal (*Cirrhinus mrigala*), silver carps (*Hypophthalmichtys molitrix*), grass carp (*Ctenopharyngodon idella*) and common carp (*Cyprinus carpio*) were stocked, but their ratio and stocking density varied as per need. The four interventions demonstrated at seven locations and carried out under participatory mode are discussed below.

Table 2. Details of intervention demonstration and SHG or individual involved .

Name of SHG / Individual farmer	Village	Size of field	Intervention
SHG – Nav Jyoti (4 members)	Aspura	459m^2 (fish refuge 134 m^2)	Rice fish cultivation under seasonal waterlogged are using pens.
SHG – Nav Yuvak (10 members)	Harpura	240 m^2	Fish culture under waterlogged area using pen
Sh Chandra Singh	Aspura	258m^2 (fish refuge 31 m^2)	Rice fish cultivation under tubewell irrigation with collection of some runoff water
Sh. Suresh Singh	Aspura	352 m^2	Fish culture in abandoned pits
Sh Upendra Sharma	Danara	Two pits of 200 m^2 each	Fish culture in abandoned pits
Sh. Kamlesh Singh	Harpura	180 m^2	Fish culture in abandoned pits

3.2 Rice-fish farming under irrigated condition

In order to enhance the productivity of rice-cultivation, fish was also introduced in the rice field. As per the concept of rice-fish farming, fish incorporation in the field also benefit the rice crop as it reduces infestation of disease and insect. If grass carp is stocked in small quantity, it reduces the weed infestation. But, fish requires a refuge to be dug out in the rice field covering an area of 10-20%, which will provide shelter to fishes under unfavourable conditions, e.g. fluctuations in temperature and dissolved oxygen, lowering of water level, application of pesticides, and also helps in harvesting.

Mr. Chandra Singh of Village Aspura undertook this intervention on his field measuring 51.6 x 5.6 m (nearly 289 m^2). The field was a in the shape of long strip with length to width ratio of 9.2, not congenial for fish related interventions (Fig.8). But keeping the wishes of farmer and available options, it was selected for the intervention. Two refuges (75 cm deep) were dug out covering 15.7 m^2 of each located at both the ends of the field.

Rice Production: Seedlings (35 days old) of MTU 7029 were transplanted on 31st July 2003 and harvested on 7th December 2003. Normal agronomic techniques were followed as per the farmer's own practices. Enough provision for rainwater harvesting was made by keeping bund height more than 25 cm. But, due to lowering of water level in the field below 10 cm, farmer applied two irrigations roughly of 3-4 cm each using his tubewell & pump.

Fish Production: Five fish species were stocked in a ratio: Rohu (10%), Mrigal (30%), Grass carp (15%), Silver carp (5%), and Common carp (40%) with stocking density of 10,000/ha

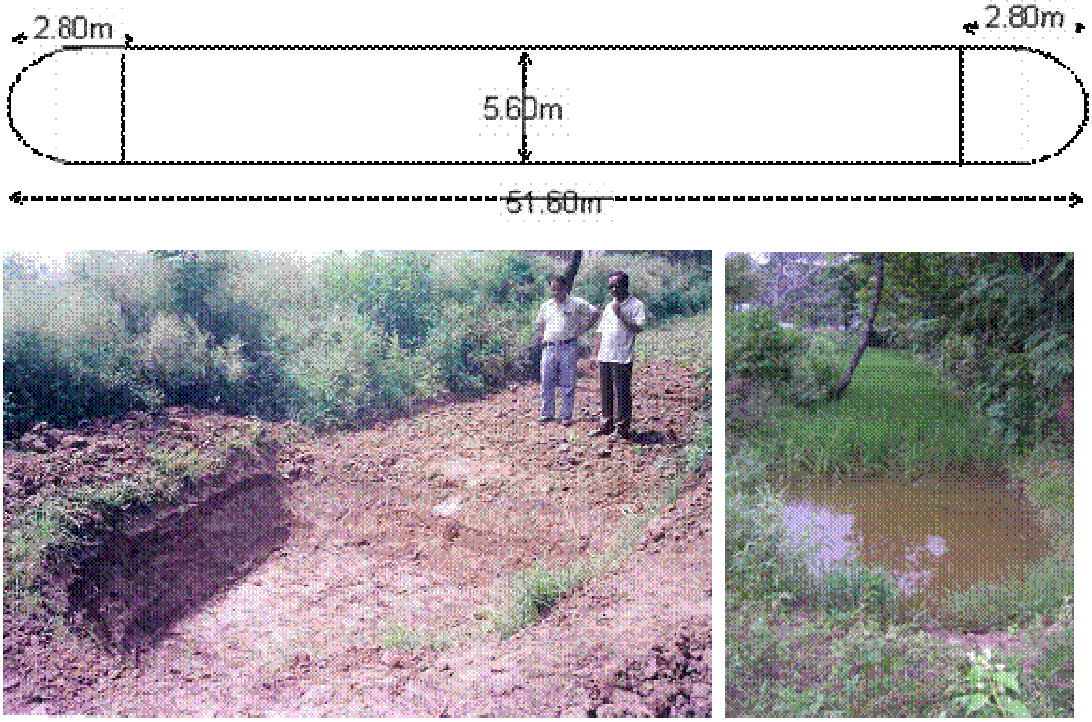


Fig. 8 Rice-fish farming in irrigated conditions

of gross area on 4th August 2003. The harvesting was done between 13-18 November 2003 as the water level got lowered below ground level and rice was picking maturity.

3.3 Rice fish farming in seasonally waterlogged areas

Under seasonal waterlogged condition, production of even rice crop is difficult as the water level frequently changes and has relatively deeper water. Under this condition, raising of field level using soil excavated from nearby fields may be an option which is being used in the project area. However, if the excavation is made under planned way such that the dug out pit can be used as refuge for fish culture, and rice production in raised field, the productivity may be enhanced substantially. This concept was attempted with the participation of a SHG. An interest group of four members was formed among the ten members of Self Help Group - Navjyoti in village Aspura located in the head reach of the command.

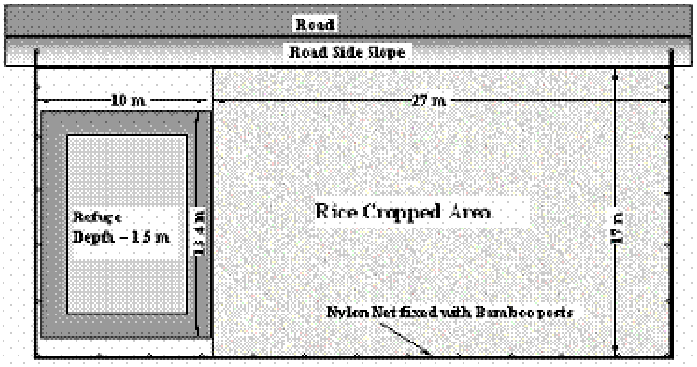


Fig. 9. Sketch of the field layout for rice-fish farming in

Fig. 10. Rice-fish farming in waterlogged areas

This group took initiative to begin the rice-fish culture in waterlogged area. A patch of land (37 x 17 m) under waterlogging was adopted on lease (@Rs 200/yr). This field was located on the roadside as shown in Fig. 9. A refuge of 13.4 x 10 m (1.5 m deep) was dug on one side and the excavated soil was spread on an area of 27 x 17 m, which raised the bed level by 35 cm. Such level raising made the field suitable for rice cultivation (Fig. 9). The field was isolated from rest of the waterlogged area using nylon pen (Fig. 10). Before initiation of flooding, nylon net (mosquito net) stitched with nylon rope on both sides, was fixed on the three sides of the field using bamboo with about 6" remaining below ground level. On the fourth side (road side), such protection was not needed.

Rice Production: On the raised bed, 36 days old seedlings of rice (variety MTU 7029) were transplanted on 31st July 2003. The fertilizer use in the rice field was around 5 kg of urea along with poultry manure (40-50 kg). The rice was harvested on 26th December 2004.

Fish Production: The refuge was prepared with eradication of any trace of wild fishes using bleaching powder, followed by application of lime (2.7 kg), urea (0.65 kg), SSP (1.30 kg) and MOP (0.13 kg) along with poultry manure (about 10 kg). Fries of composite fish species in the ratio: catla (10%), rohu(10%), mrigal (30%), grass carp (5%), silver carp (5%) and common carp (40%), were stocked @ 7500 / ha of gross area or 35000 per ha of refuge area, on 4th August 2003. Fish feeding with rice bran and mustard cake (in 2:1 ratio) initially @ 50 g/day, and to be increased to 200-250 gram was suggested. As per the wishes of the group, fish was not harvested with rice harvesting, but, fish was harvested in three phases on 31st December 2004, 24th February 2004 and 10th May 2004.

3.4 Fish culture in depression in waterlogged areas

In waterlogged areas, the water level mostly fluctuates between 30 – 100 cm, depending upon the water flow in that area from runoff or other sources, and the duration of such water stagnation also varies considerably. Fish culture under such condition may not be remunerative. To make such area congenial for fish culture, a depression is required in the form of fish refuge, which can have water level varying between 1.0 – 2.0 m and will provide shelter to fishes under unfavourable conditions. In village Harpura, one such small pit existed, which was dug out for soil for house construction. One SHG – Nav Yuvak having 13 members belonging to landless class earning livelihood through agricultural or urban labour, undertook fish culture under waterlogged areas by taking the depression (pit) on lease. The pit was isolated from the surrounding waterlogged area using nylon net fixed on bamboo posts (Fig. 11). The size of the pit was 24 x10 at top and 22 x 8 m at bottom with 1.6 m depth.

Fig.11. Farmer indicating flooding level and nylon pen around the pit with fish harvesting in inset

Fish of six species were stocked in the ratio: catla (35%), rohu (35%), mrigal (8%), grass carp (10%), silver carp (5%) and common carp (7%) on 4th August 2003. The group followed fertilization and fish feeding as suggested. Fish harvestings were done on 31st December 2003, 28th March, 26th April and 7th May 2004.

3.5 Utilisation of small abandoned pits for multiple uses

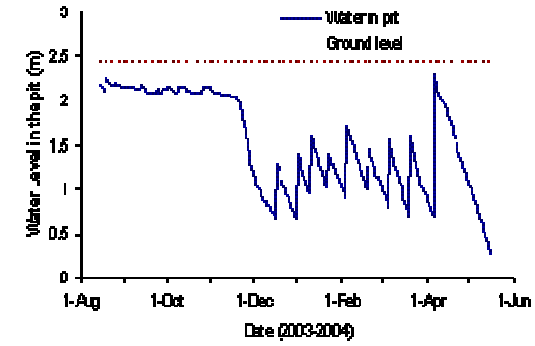
There are several small and abandoned pits available in the project area. These pits were dug to borrow soil to raise field level, house construction or other purposes. These are quite small measuring 150 m^2 to as big as 500 m^2 and are unsuitable for commercial fish culture. However, as the pits were kept abandoned, it was discussed with the owner to utilize these for beneficial purposes. Fish culture in the pond and horticulture/vegetable/pulses as desired, may be planted on bunds to utilize seepage water. To initiate such activities, three farmers came forward for fish culture in their pits (Table 1).

Mr. Suresh Singh (vill. Aspura): He has a relatively bigger pit (22 x 16 m, 352 m^2, 2.45 m deep). The bottom of the pond was not in proper shape, and it was newly dug out. It is located in the head reach and seepage water mainly contributes to water storage in the pond, while it also has provision of filling by diverting canal water or tubewell. In this manner, he supplemented the water in the pond nine times (Fig. 12c). He did necessary cleaning of the sides and bottom as recommended. Fish fries were stocked on 4th August 2003 at ratio: catla (35%), rohu (35%), mrigal (8%), grass carp (10%), silver carp (5%) and common carp (7%) at a density of 25,000 fry/ha. The fish harvesting was done in two parts, i.e. on 24th February 2004 and between 10th – 18th May 2004 as per market availability to sell the fish.

Mr. Kamlesh Singh (vill. Harpura): He has very small pit (16 x 13 m at top 14 x 11 m at bottom, 2.45 m deep and normal water spread area of 180 m^2). Fish stocking ratio was same as that of Mr. Suresh Singh, and made on 4th August 2004. The harvesting was followed as per the wishes of the farmer and it was mostly consumed in his home only. A total of 26.8 kg (1.49 t/ha) of fish was harvested on five dates between 10th October 2003 and 7th March 2004.

(a) Before inception of project

(b) Fish production (2003-2004)



(c) Water level fluctuation in the pond

(d) Adoption of banana plantation and pigeon pea cultivation on bunds

Fig. 12. Multiple uses adopted by Mr. Suresh Singh

Mr. Upendra Sharma (village Danara): He has two small pits (both 20 x 10 m size, 1.5 m deep). The fish stocking was similar to Mr. Suresh Singh. However, the fish feeding and fertilization could not be followed as recommended, because of his engagement with his ill father and demise of his father. Hence, the growth of fishes was not as expected. Up to 10th May 2004, a total of 13.9 kg (0.7 t/ha) and 21.9 kg (1.09 t/ha) of fish (larger than 100 g) were harvested, respectively from the two ponds, while the small size fishes were left for further growth. General assessment revealed that the total fish harvested would have been more than 1.0 t/ha if all the fishes were harvested.

Fig. 13. Abandoned pit of Mr. Kamlesh Singh (Village Harpura)

Fig. 14. Fish harvesting in pit at Danara.

4.0 Results and Discussion

All the interventions implemented in the farmers' fields were successful and created enthusiastic response among the farmers. They obtained good return from the small expenditure incurred in all the interventions and their unproductive land was put to productive utilisation. The benefits from the interventions were analysed by the farmers and they provided the information on different components of economics. The economical analysis was undertaken in consultation with them and discuused with the others in meetings. Annualised cost of earthwork excavation or other fixed inputs were worked out considering a life of 25 years for excavated refuge or pits and 3 years for nylon net & bamboo and 9% interest rate.

Table 3 Economics of fish culture in rice fields under irrigated conditions

Particulars	Amount (Rs)
Cost of refuge digging	750
Annual cost of digging.(25 yr life; 8% interest)	76
Annual Maintenance	40
Paddy production lost in refuge area	59
Expected loss for rabi crop	59
Cost of Irrigation (Fuel)	50
Cost of Fish fingerlings	50
Feed and Misc. expend.	50
Total expenditure	384
Return from selling fish (Rs)	640
Benefit	256
Benefit (Rs/ha)	8858

4.1 Intervention-wise results

- In rice-fish farming under tubewell irrigation condition, the rice yield was 3.77 t/ha and fish yield was 442 kg/ha of rice-fish area or 4.08 t/ha of refuge area. The economics given in Table 3 indicates that a net benefit of Rs 8880/ ha can be obtained over traditionally grown rice alone.
- The rice production on the raised fields in the waterlogged area was 5.6 t/ha, which is more than that of grown under irrigated condition. The water accumulation started since mid-July and reached to above raised field level by end of July and remained so up to end of November 2003. The water level fluctuated between 13 and 30 cm above the raised field level up to end of October (Fig. 15). The water level was influenced by rainfall as well as release of canal water in the command. A total of 32.00 kg of fish was harvested in three phases of harvesting. Economic analysis was made considering two components of the system i.e. rice production and fish production (Table 4). Digging of refuge and spreading of soil on the field to raise its level was necessary for rice cultivation, whereas nylon net pen was required to culture fish. The cost was considered accordingly. The net

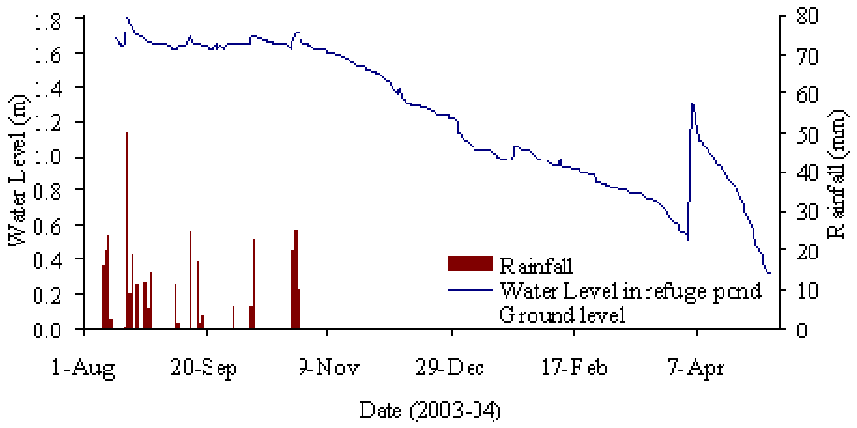


Fig. 15 Water level fluctuation in refuge and rainfall

Table.4. Economical analysis of the rice-fish culture under waterlogged condition.

Expenditure			Paid by	Gain		
Item	Quantity	Cost (Rs)		Item	Quantity	Income (Rs)
A. For Rice Production						
Digging and spreading of soil	160 m^3	4,000	Farmer	Paddy	257 kg	1,285
Annual cost of digging (25 yr life)		407	Farmer	Straw	250 kg	100
Annual maintenance		50	Farmer	Total		1,385
				Net Profit from		
Cost of rice production		375	Farmer	**rice**		**553**
Total annual cost of rice production		**832**		**Net Profit /ha#**		**8,792**
B. For fish production						
Nylone net*	76x 1.2 m	1,006	Project	Fish	32 kg	1920
Bamboo		150	Farmer			
Annual cost of net (life 3 yrs)		457				
				Net Profit from		
Fertilisers		60	Project	**fish**		**1,003**
Fingerlings		100	Project	**Net Profit /ha#**		**15,946**
Bamboo cutting and fixing		50	Farmer			
Fish feeding		250	Farmer			
Total annual cost of fish production		**917**		**Total Net Profit (rice & fish)**		**1,556**
				Total Net Profit (including		
C. Lease for the land		**200**		**lease)**		**1,356**
				Total Net Profit /ha#		**21,558**

*Complete stitched with ropes at both end: 9% interest assumed; # Based on gross area=rice + refuge area = 629 m^2

profit from putting the area under rice culture was about Rs 8,800 /ha while from fish, it was nearly 16,000/ha. Considering the amount paid in lease (Rs 200), the overall profit was 21, 500 / ha, which is quite an encouraging, as earlier farmers were only getting only 10-12 kg of wild fish (0.15 – 0.2 t/ha) from the entire area.

- From August to end of October, the water level in the pit fluctuated between 1.84 m to 2.02 m, and thereafter started declining at a faster rate and reached 0.68 m on 16th December 2003. Encouraged by the results of fish sampling and growth, the group decided to fill the pit by diverting canal water on 23rd January 2004 (Fig. 16) for further growth of the fishes. Fish yield of 52.7 kg (2.38 t/ha) was harvested from the nylon pen created around a pit in waterlogged area. However, the group did some fish harvesting on their own for family consumption which was not recorded. On the basis of information provided by the group, economic analysis was done as given in Table 5. Total earning was around Rs 4000/- with a net profit of about Rs 1600/-. In comparison to previous years earning of Rs 1400/- through wild fish harvesting, it was found beneficial to have fish culture. In February 2004, it was noted that a part of the net was raised on one side to check escape of fishes. The lease amount of Rs 1100/- for a patch of 240 m^2 is quite high, which is also

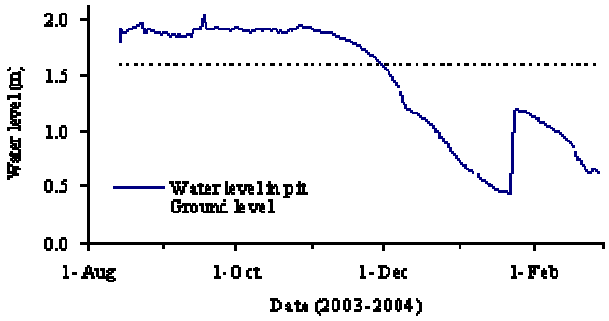


Fig. 16 Water Level fluctuation in the pit under waterlogged area

responsible for less profit than the expected.

- A total of 61.2 kg fish (1.88 t/ha) was harvested by Mr Suresh Singh from his pit (352 m^2), and sold on varying prices. Considering Rs 50/kg, total return was Rs 3060/-. The cost involved was Rs 700-800. Hence, there was a net profit of more than Rs 2250/- that amounts to nearly Rs 64,000/ha. Ecouraged by the results, the farmer also adopted growing of horticulture and pulses on bunds, to further enhance his profit (Fig 12 d).

Table 5. Economics of fish culture in pit under waterlogged condition

Paticular	Amount (Rs)	Contributed by
Cost of Nylon net	925.00	Project
Cost of bamboo	480.00	SHG
Annual cost of net & bamboo*	555.05	
Fixing charges for pen	100.00	SHG
Cost of fish fingerlings	200.00	Project
Fish feed	400.00	SHG
Fertilisers	35.00	Project
Cow dung	20.00	SHG
Cost of lease	1100.00	SHG
Misc.	100.00	SHG/Project
Total Cost	2410.05	
Earning from fish selling	4000.00	
Benefit	1589.95	

*3 yr life, 9% interest

- For other small pits the fish yield varied between 1.0 to 1.5 t/ha, which was mostly consumed by farmers in their own family or sold in the villages. Although, the small amount of fish harvested from the small pits cannot be used for commercial purposes, but it created awareness about cultured fish cultivation and gave some income from the abandoned pits. This certainly provided a good opportunity for resource poor farmers who own small patch of lands.

5.0 Response of farmers

After completion of one season, feedback and responses of the community were collected. There was an overwhelming response and more than 83% (of 75 respondents) farmers were willing to take up the fish production in one form or the other. However, variation in the response was observed. Because of religious reason, the middle reach farmers are less (only 70%) willing to grow fishes, while in head (88%) and in tail reach (96%) farmers are more willing to go for aquaculture. Before the inception of the project, farmers were hesitant to grow fish. After getting information, they have shown willingness. Self-observation of demonstrations, interaction with the ICAR scientists or other farmers, and communication materials such as leaflets were found to be the major source of information

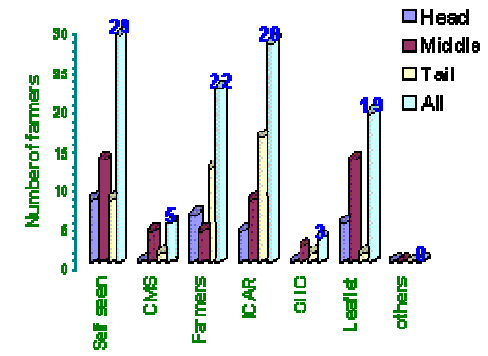


Fig 17 Source of information to the farmers (number of farmers out of 75)

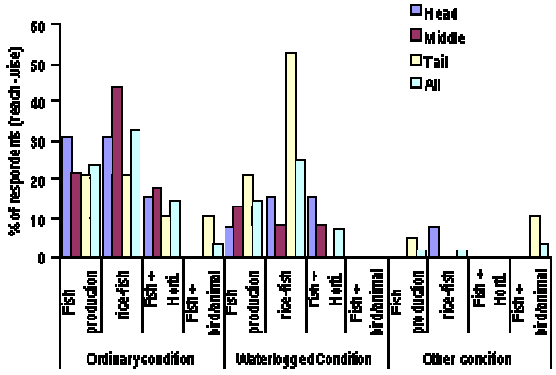


Fig. 18 Response toward different interventions

(Fig. 17). Rice-fish farming was the most attractive intervention for the head and middle reach farmers, while tail reach farmers like to have rice-fish farming in waterlogged condition. However, the problem of security, non availability of the fish fingerlings, were expressed as the bottlenecks in adoption of the interventions on large scale.

6.0 Conclusions

Productive utilization of under-utilized or un-utilized seasonal waterlogged areas, depressions and abandoned pits has been successfully demonstrated following a participatory approach. Poor farmers including landless and/or small holders came forward to undertake multiple uses of water with aquaculture interventions as the core activity with whatever limited resources they had for improving their livelihoods. The results of these interventions produced an overwhelming response and their benefits have already started to spread through word-of-mouth. Villagers are enthusiastically taking up these interventions and more than 20 farmers/groups have already approached ICAR-RCER for technical support for adopting these interventions.

One of the lessons learnt is that such need based, low-cost interventions supported by proper communication process could be easily undertaken by the farmers using their own resources.

Multiple use of seasonally waterlogged areas (including such areas that are near the canals) to enhance water productivity will require a definitive policy from the Canal Department to lease such lands to SHGs or other interest groups.