

# Boosting rice production

RIU

## Validated RNRRS Output.

In India, work has been done to bridge the 'production gap' between current and potential levels of production in high-potential, irrigated rice systems. This is often the result of farmers not taking up new technologies as a result of poor communication. They need to know, for example, that using both groundwater and surface water means that they can plant and harvest early and still have time to grow a wheat crop. In India, this and other techniques were tested and then promoted using a low-cost communication strategy, including field-based demonstrations and the production of communication products in Hindi. These made clear to producers the benefits of establishing rice nurseries early. They also showcased the benefits of using the water available in rice systems for more than one thing—such as aquaculture.

Project Ref: **NRSP23:**

Topic: **4. Better Water Harvesting, Catchment Management & Environments**

Lead Organisation: **GY Associates, UK**

Source: **Natural Resources Systems Programme**

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[Description](#), [Validation](#), [Current Situation](#), [Current Promotion](#), [Impacts On Poverty](#), [Environmental Impact](#),

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## Description

## Research into Use

NR International  
Park House  
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ME20 6SN  
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## Geographical regions included:

[India](#),

## Target Audiences for this content:

[Crop farmers](#), [Livestock farmers](#), [Fishers](#), [Forest-dependent poor](#),

## **NRSP23**

### **A. Description of the research output(s)**

*1. Working title of output or cluster of outputs.*

*In addition, you are free to suggest a shorter more imaginative working title/acronym of 20 words or less.*

Strategies for participatory irrigation management and multiple water use, supported by interactive decision support tools.

*2. Name of relevant RNRRS Programme(s) commissioning supporting research and also indicate other funding sources, if applicable.*

Natural Resources Systems Programme (NRSP)

*3. Provide relevant R numbers (and/or programme development/dissemination reference numbers covering supporting research) along with the institutional partners (with individual contact persons (if appropriate)) involved in the project activities. As with the question above, this is primarily to allow for the legacy of the RNRRS to be acknowledged during the RIUP activities.*

R7830, R7839 and PD 140. Antecedent projects: R7000, R7001, R7600, R7458.

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*4. Describe the RNRRS output or cluster of outputs being proposed and when was it produced? (max. 400 words).*

*This requires a clear and concise description of the output(s) and the problem the output(s) aimed to address.*

*Please incorporate and highlight (in bold) key words that would/could be used to select your output when held in a database.*

**The problem:**

Consultation with international researchers and stakeholders including representatives from the Indian Council for Agricultural Research (ICAR) and regional research organisations in 1997 (R7000 and R7001) framed as a key challenge the **'production gap'** between current and potential levels of production in high-potential, irrigated rice systems.

The ICAR national workshop 'Long-term soil fertility management through integrated plant nutrient supply' (1998) identified lack of adoption of research products as crucial in the failure to achieve expected increases in production.

Research in India (R7458) and Bangladesh (R7600) in 1998-2001 identified issues of communication and service delivery as critically affecting uptake of technologies. ICAR's Natural Resources Management Directorate worked with NRSP to develop a research effort (R7830 & R7839) testing an institutional approach to **enhance social capital** at community level and building individuals' **financial and human capital** in order to stimulate expression of **demand for productivity-enhancing agricultural services and technologies**

Project R7830 focused on ways to improve productivity of canal-based irrigation through adoption of strategies for **conjunctive use of water** that enable advances in dates of **rice and wheat** sowing (with consequent increases in yield) while also encouraging crop diversification and multiple uses of water.

### The Output:

A strategy for **participatory irrigation management (PIM)** capitalised on **enhanced social capital** at a community level achieved through the use of the **"dialectic approach"** (See separate proforma for R7839).

A key element of PIM is that it does not rely on incentives or other commitments between users and motivators. A low-cost communication strategy used (i) field-based technology demonstrations and (ii) communication products in Hindi to raise awareness and promote evaluation (using a dialectic approach) of

- early-establishment of rice nurseries (using groundwater or seedlings raised in lower-lying areas) to optimize transplanting date and enable subsequent timely sowing of wheat, and
- multiple uses of water including aquaculture and growth of high-value crops.

**Simple interactive decision support tools** are used to support dialogue and critique options. A **water-balance model** linked to a **GIS database** is used to examine the effect of management changes on water distribution, and a **financial model** (programmed in Visual Basic, in English and Hindi) allows exploration of the financial implications of options for conjunctive water use.

As well as using these tools within the community, communities used model outputs to substantiate their concerns when communicating to stakeholders such as canal managers at state level and in promoting project findings nationally.

5. *What is the type of output(s) being described here?*  
Please tick one or more of the following options.

<b>Product</b>	<b>Technology</b>	<b>Service</b>	<b>Process or Methodology</b>	<b>Policy</b>	<b>Other Please specify</b>
X	X		X	X	

6. What is the main commodity (ies) upon which the output(s) focussed? Could this output be applied to other commodities, if so, please comment

The approach was used to increase productivity within areas dominated by irrigated rice and wheat production system.

Increased productivity of the system was achieved both through increases in rice and wheat yield as well as encouraging production of other agricultural products, such as livestock (cattle, goats, chicks and aquaculture), vegetables and other high value crops.

Aquaculture was promoted in waterlogged areas and groundwater enabled high value vegetable crops to be produced on areas outside the canal irrigated area unsuitable for rice or wheat and on upland soils.

7. What production system(s) does/could the output(s) focus upon?

Please tick one or more of the following options. Leave blank if not applicable

<b>Semi-Arid</b>	<b>High potential</b>	<b>Hillsides</b>	<b>Forest-Agriculture</b>	<b>Peri-urban</b>	<b>Land water</b>	<b>Tropical moist forest</b>	<b>Cross-cutting</b>
	X				X		

8. What farming system(s) does the output(s) focus upon?

Please tick one or more of the following options (see Annex B for definitions).

Leave blank if not applicable

<b>Smallholder rainfed humid</b>	<b>Irrigated</b>	<b>Wetland rice based</b>	<b>Smallholder rainfed highland</b>	<b>Smallholder rainfed dry/cold</b>	<b>Dualistic</b>	<b>Coastal artisanal fishing</b>
	X	X				

9. How could value be added to the output or additional constraints faced by poor people addressed by clustering this output with research outputs from other sources (RNRRS and non RNRRS)? (**max. 300 words**).

Please specify what other outputs your output(s) could be clustered. At this point you should make reference to the circulated list of RNRRS outputs for which proformas are currently being prepared.

R7830 was clustered with R7839, the projects developed and reported against a joint logframe. This represents a good example of how the "dialectic approach" developed in R7839 added value to a technology-focussed project. Further, The ICAR Research Complex for the Eastern Region (IRCER) clustered this output with their ongoing research both during and post project as reported under the sections on validation.

R7830 focused PIM, but an important finding was that the approach enabled (and stimulated interest in) aquaculture. There is likely to be added value in clustering R7830 with outputs of aquaculture research undertaken within RNRRS.

Suite 1 of the NRSP India node: 'Policy process for pro-poor rural services' developed technologies for aquaculture in seasonal water bodies (R6759) that are directly relevant to the seasonally waterlogged areas. Further, the strategies for policy engagement (R8100) may add value to R7830. Conversely the "dialectic approach" and service provision models demonstrated by R7839 and R7830 may prove more cost effective and add value to the approaches for service provision tested by R8334.

Fisheries Management Science Programme: projects within the clusters 'Floodplain Fisheries Management' and 'Enhancement of Inland Fisheries', which relate to socioeconomic benefits of enhancement of floodplain fisheries, to use of sluice gates for stock enhancement, and to promotion of FMSP guidelines for floodplain fisheries management and a fisheries enhancement decision support toolkit. (Projects R6494 R8210 R8486 may have particular relevance to R7830). Further, projects within the 'Integrated Aquatic Production for Rural Livelihoods' cluster of the Aquaculture and Fish Genetics Programme appear to offer potentially useful outputs.

## Validation

### **B. Validation of the research output(s)**

#### **10. How were the output(s) validated and who validated them?**

*Please provide brief description of method(s) used and consider application, replication, adaptation and/or adoption in the context of any partner organisation and user groups involved. In addressing the "who" component detail which group(s) did the validation e.g. end users, intermediary organisation, government department, aid organisation, private company etc... This section should also be used to detail, if applicable, to which social group, gender, income category the validation was applied and any increases in productivity observed during validation (max. 500 words).*

Validation involved two phases, the "broad-based Participatory Irrigation Management (PIM)" approach was **piloted** in the project target area alongside the "dialectic approach" to social mobilisation via self-help groups developed by our sister project R7839 (see separate proforma). This in turn facilitated both the PIM approach and the methods developed for participatory technology development in R7830.

Having piloted the PIM approach, the project engaged secondary stakeholders at both state and national level in evaluating the implications of adopting the approach.

#### **Piloting**

The project was built on the diagnosis that irrigation problems lay 'below the outlet' with distribution problems between top-end and bottom-end leading to inefficiency and inequity in water use. The pilot thus encompassed all the villages (approximately 20) from the top to bottom end of a single distributary, in an area where official

State Government statistics suggest 40% of the population are below the poverty line. Prior to the project, water users' associations (WUA) formed amongst land-owning members took decisions related to water management. The WUAs, and their associated committees focused on the interests of their land-owning member farmers who typically represented the "moderate poor" (by the Hobley and Jones classification) or non-poor.

The project facilitated poor cultivators (sharecroppers and *rehan* – bonded labourers) to engage in a dialogue around efficient use of land and water including engagement with local canal management officials, with support of the ICAR research Institute involved as an extension service provider. This support included scientists taking on a consultancy role, and the use of decision support tools, described above, to support the community in their engagement with local canal management officials.

Marked productivity improvements were observed during the pilot. Increases in the use of groundwater to raise rice seedlings enabled early rice transplanting and timely establishment of wheat; this led to a doubling of crop yields in areas that adopted the practice.

In addition to increases in rice and wheat, a third crop was introduced in some areas and some extremely poor people took advantage of expansion of the groundwater market to bring marginal land into production for high value crops, as well as engaging in aquaculture by making use of seasonally waterlogged areas.

#### **Validation by secondary stakeholders:**

The pilot testing of the new "broad-based PIM" approach provided a resource that could be used for wider validation purposes. In 2004 the project encouraged validation through

1. State level workshops and stakeholder dialogue
2. National level evaluation

The Key messages were:

1. that although OFWM solutions exist for improved distribution, these could not be realised without confidence in main canal management.
2. That opportunities for aquaculture exist on the areas of land under Gov't control that are seasonally waterlogged.
3. that a broad-based approach to PIM enable effective use of available water resources.

#### **11. Where and when have the output(s) been validated?**

*Please indicate the places(s) and country(ies), any particular social group targeted and also indicate in which production system and farming system, using the options provided in questions 7 and 8 respectively, above (max 300 words).*

#### **Pilot testing by R7830**

Project R7830 developed / piloted the PTD and PIM approach between 2002 and 2004 in the Sone Canal system, Right Parallel Channel V, Patna, Bihar, India. As was described above the outputs were evaluated by stakeholders in PIM at the State and National level.

The state-level evaluation with secondary stakeholders (between 2004 and 2006) involved informal workshops, where community members and project scientists used the experience at the project area to demonstrate the potential benefits of the “broad-based PIM” approach. Community members and WUA, were able to help the researchers to use their decision support tools to convince local officials of the implications of main canal management. This was initially focused within the Patna District by IRCER. However increasingly the ongoing validation is being undertaken by a number of organisations within Bihar as described below (Q 12 & 13).

Validation remains focused on high-potential, irrigated rice systems.

At a national and international level the pilot study was used as an example a new approach to PIM stakeholders from a wide range of organisations including Water Resources Dept, Agriculture Dept, the State Agricultural Universities, Fisheries Dept, NGOS compared and contrast experiences.

A key aim of the collective group was to inform and influence the policy and programmes of the Ministry of Water Resources. The group subsequently validated and elaborated the concept of “broad-based PIM” that was further promoted as described in section D.

## Current Situation

### C. Current situation

#### 12. *How and by whom* are the outputs currently being used? Please give a brief description (**max. 250 words**).

The practice of early crop establishment is being used by farmers in the project area and in surrounding villages. Extreme poor members in these communities have both adopted and expressed interest in the adoption of aquaculture and other agricultural activities. Empowered through the community development activities these groups have, with the support of IRCER and other agencies, convinced the Gov’t of Bihar has agreed to change the leasing arrangements for both perennial and seasonal water-bodies allowing for investment them in aquaculture.

IRCER have adopted the low cost approach for service delivery. They have initiated a “Technology Acceleration Programme” (TAP) that used the findings of the project and the low cost communication strategy (using targeted demonstration, communication products and consultancy type support where needed) to continue to promote PIM (and the associated technologies) within Bihar.

The Chief Minister of Bihar has proposed the adoption of the TAP at a state level and ICAR have approved a “special fund” to support this.

Additional funding has been secured from USAID and IFAD to support the further development of the “broad-based PIM” approach. The “broad-based PIM” approach is being adopted and further promoted by the Water Resources Dept (WRD). WRD have commission the IRCER to provide training for their staff to enable implementation of the approach.

**13. Where are the outputs currently being used? As with Question 11 please indicate place(s) and countries where the outputs are being used (max. 250 words).**

Current use is focused primarily within India, with a focus on the State of Bihar although the wider relevance of the “broad-based PIM” approach has been recognised through national validation efforts.

The PIM approach has been adopted by the Bihar WRD in four Command Areas in Bihar: Sone, Gandak, Kose and KBC.

Scaling up of the TAP has begun with the State Agricultural University (SAU) and associated extension centres (KVKs) at Nalanda District and will be rolled out across Bihar.

**14. What is the scale of current use? Indicating how quickly use was established and whether usage is still spreading (max 250 words).**

Within the life of the project the early rice transplanting and wheat establishment spread rapidly within the project area, initial farmer trials were undertaken over 135 ha in 2001, by 2002 this area expanded to 820 ha, with partial adoption on a further 2200 ha. By 2004 the practice had spread to 178 surrounding villages.

Currently the “broad-based PIM approach” being promoted by the WRD staff in four Command Areas, together these represent an area of over 2M ha. At this stage it is too early to report levels of adoption and use at the community level. But WRD have an ongoing commitment to support this and have commissioned the ICAR Research Complex for Eastern Region to provide training for WRD implementation staff on an ongoing basis.

The Chief Minister of Bihar wishes to adopt the programme at a state level and ICAR have approved a “special fund” to support this. The first demonstration and promotion activities have begun in the Nalanda District, and will be rolled out Statewide through. Primarily in partnership with the existing network of KVKs.

In summary:

<b>State</b>	<b>Districts / Command</b>	<b>Date</b>	<b>Villages</b>	<b>Status</b>
Broad-based PIM				
Bihar	Patna	2005-present	15	IRCER Technology Acceleration Programme (TAP)
	Patna / Vaishali	2004-present	8	IRCER with USAID / IFAD funds
	Nalanda	2006-present		Initial pilot initiated using ICAR special funding to scale up TAP state wide
	Sone, Gandak, Kose and KBC command	2006-present		WRD have commissioned IRCER to provide training to their staff in the commands listed



15. *In your experience what programmes, platforms, policy, institutional structures exist that have assisted with the promotion and/or adoption of the output(s) proposed here and in terms of capacity strengthening what do you see as the key facts of success? (max 350 words).*

The strategic positioning of the research was agreed between ICAR and DFID NRSP as described in section A. This ensured that the research reflected an area where the Indian Gov't saw a need for progress to be made.

Having engaged ICAR at a senior level (ICAR Deputy Director) ownership of the outputs by ICAR was ensured from the outset of this project.

This project was led by an ICAR Research Institute and ICAR created the flexibility and provided the encouragement to scientists to use the project resources to test an innovative new approach. External donor support provided the resources that enabled the approaches to be developed and tested.

For example this flexibility enabled the project to involve and work with private sector development professionals as full partners in the innovation and research process (at the time of this project inception this idea was rather controversial).

ICAR became advocates for the project outputs with appropriate state and national agencies who they saw as likely to draw on the outputs. The project provided resources to support this promotion.

An increasing awareness of the need (at all levels) for institutional change and the importance of learning from innovative projects has led to an appetite for change currently being supported by the National Agricultural Innovation Project (NAIP) of ICAR.

Recognising that the project approaches represented a important institutional innovation, ICAR (NAIP) and the National Centre for Agricultural Economics and Policy (NCAP) sought to learn further from the experiences of this project and other projects in India that had tried innovative institutional approaches.

This learning approach was only possible because ICAR and other organisations felt ownership – it was seen and promoted as an “*Analysis by Indian scientists, development professionals and Gov't staff of their own Indian experiences*”.

As a consequence it was recognised that most examples of innovation in research approach partnership and interdisciplinarity had arisen in projects that were not funded directly by ICAR however the findings of what worked, and what didn't, fed directly into the design of a \$250M investment by ICAR in NAIP that aims to develop capacity of the Indian Innovation system.

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## Current Promotion

### D. *Current promotion/uptake pathways*

16. **Where** is promotion currently taking place? Please indicate for each country specified detail what promotion is taking place, by whom and indicate the scale of current promotion (**max 200 words**).

#### **Targeted local advocacy by IRCER with the Canal Department**

Promotion in partnership with local communities continues to raise awareness of the benefits of the 'broad-based' PIM approach.

#### **National level promotion by ICAR**

Initially (2003) the project raised awareness of the PIM approach by briefing the Commissioner, Canal Area Development Agency (CAD) of the Ministry of Water Resources who joined working group sessions of the project's Delhi workshop in August 2004. At the Commissioner's recommendation the Under Secretary, attended a project workshop and reported to the Chief Minister.

in 2006 ICAR-CAD jointly sponsored "National Workshop on Water Productivity" attended by representatives from the Central Water Commission, Central Groundwater Development Board, SAUs, ICAR, KVKs, CAD representatives and WRD, NGOs, Ministry of Agriculture and WALMI promoted the findings more widely. The workshop formally recognized the "broad-based PIM approach".

This has been followed by State level validation by WRD.

#### **Promotion on innovation learning by ICAR**

ICAR Natural Resources Directorate and NRSP supported a workshop "Learning from Institutional Change" (2005). Workshop findings were used in the design of NAIP and the written products are currently being provided by NAIP as a resource to organisations preparing consortia proposals to NAIP.

17. **What are the current barriers preventing or slowing the adoption of the output(s)?** Cover here institutional issues, those relating to policy, marketing, infrastructure, social exclusion etc. (**max 200 words**).

The project created significant awareness of the benefits of a 'broad-based' approach to PIM. IRCER has been commissioned to provide training to the WRD Staff in four Commands in Bihar. Adoption is ongoing in Bihar as reported above.

Formal mechanisms do not currently exist to assess and evaluate the impact of the PIM and PTD interventions and technologies in these new area and to document lessons learnt during adoption.

Validation of the broad-based PIM approach by stakeholders at a national level suggested that the PIM approach will have widespread relevance beyond Bihar. A barrier to adoption is i) a lack of appropriate pilot or demonstration cases to as an evidence base to confirm the relevance in contrasting situations of India; ii) availability of effective communication strategies and associated communication materials to promote adoption and iii) the availability of resources for continued promotion.

In situations where WUAs exist favouring the moderate poor, there is a need to support processes such as the "dialectic approach" that will enable the extreme poor and socially disadvantaged to engage with existing

institutions is required. Innovative mechanisms are needed to mobilise financial resources to enable the use of the dialectic approach and “broad-based PIM”.

*18. What changes are needed to remove/reduce these barriers to adoption? This section could be used to identify perceived capacity related issues (max 200 words).*

***Revise CAD Guidelines to reflect the “broad-based PIM approach”:***

The Ministry have accepted the principle of the “broad-based PIM” approach and have encouraged further validation. Scope exists for revision of the CAD guidelines to enable scaling up in other areas.

***Regulations and norms related to micro-finance and SHG formation:***

The successes reported by both R7830 & R7839, depended on the “dialectic approach”. Currently the Gov’t norms and rules for engaging NGOs to support development activities and private sector norms and business practices provision of cost-effective support for community development.

***Need for national level evidence base of the broad-based PIM Approach***

The PIM approach developed is currently being widely tested in Bihar. There is a need to build the capacity to support a wide-scale validation and promotion effort and to promote the findings to the State level Dept’s. The CAD Ministry of Water Resources would be a likely partner in such a venture which would build upon the existing findings and previous promotion activities.

***Need for market opportunities to add value to agricultural produce***

The market, particularly for commodity crops is limited, opportunities to add value to the products, both through post harvest processing and entry to high value markets exist but are not yet realised.

*19. What lessons have you learnt about the best ways to get the outputs used by the largest number of poor people? (max 300 words).*

***Understand uptake pathways***

As described above this output was developed from research in which Indian Gov’t research organisations had strong ownership.

***Understand the motivations of your partner for engagement.***

For example projects such as those funded by NRSP and now RIUP may represent very valuable “low risk” opportunities for ICAR and other Gov’t institutions to test new ideas and pilot new approaches. If they work well the lessons can be internalised if they fail the implications for ICAR are small.

***Understand how you are creating space for innovation and the requirements for effective partnerships***

The workshop “Learning from Institutional Change” (November 2005) confirmed that the lessons of this project represented innovative departures from the norm.

A number of factors were highlighted as important in achieving effective partnerships across diverse organisation type. Understand and appreciate these needs and respond accordingly. Sounds simple but is rarely achieved.

**Develop outputs that can be used at a relevant scale**

There is a “numbers game” involved in reaching the poor. In the areas where this research was undertaken a single extension officer has to serve the needs of approximately 100 villages. It is necessary to ensure that the research outputs are developed and tested with an explicit understanding of this.

In order to develop research outputs of relevance that would benefit the largest number of poor, it is necessary to research and develop outputs that could realistically be used at this development scale. Our analysis showed that many research intensive and costly development models (which may not be researcher intensive) failed to translate to the scales needed to have meaningful future impact.

## Impacts On Poverty

### E. Impacts on poverty to date

*20. Where have impact studies on poverty in relation to this output or cluster of outputs taken place? This should include any formal poverty impact studies (and it is appreciated that these will not be commonplace) and any less formal studies including any poverty mapping-type or monitoring work which allow for some analysis on impact on poverty to be made. Details of any cost-benefit analyses may also be detailed at this point. Please list studies here.*

No formal poverty impact studies have been carried out. Given the thrust of the project was poverty-focussed, monitoring of the poverty impact was carried out as part of the process of engagement with potential beneficiaries of the project output through piloting and validation. This process was linked to the self-help groups facilitated within project R7839 and which have been the subject of a post-project poverty review (see the separate proforma for R7839).

Evidence of the adoption and reports of livelihood benefits observed are provided at:

Singh RD, Gautam US, Sikka AK, Gaunt JL and Singh SR. 2005. Livelihood improvement through optimization of rice transplanting and timely sowing of wheat in participatory mode in RP Channel-V of Sone command. Technical Bulletin No: R-15/Pat-6, ICAR Research Complex for the Eastern Region. pp 22.

- Documents production benefits and adoption of early rice transplanting
- Provides simple financial analysis of the practice
- Summarises livelihood benefits reported by 150 community members during a survey.

Singh SS, Khan AR, Prasad LK, Sikka AK and Gaunt JL. 2006. Zero tillage technology in wheat for resource conservation, higher yield and better livelihood. Technical Bulletin No: R-20/Pat-11, ICAR Research Complex for the Eastern Region. pp 16

- Documents production benefits of adoption of zero tillage
- Provides simple financial analyses of the practice
- Summarises feedback from community members were exposed to / adopted the technology

Bhatnagar PR, Sikka AK, Singh AK and Upadhaya A. Utilization of poorly utilized land and water resources

through multiple water uses: Experiences of RPC V command. Technical Bulletin No: R-16/Pat-7, ICAR Research Complex for the Eastern Region. pp 16

- Describes multiple water use promotion
- Provides simple financial analyses of benefit
- Provides evidence of feedback from community

Khan AR, Singh SS, Prasad LK, Sikka AK, Subrahmanyam D, Singh SR and Gaunt JL. 2006. Improved livelihood and environment through deep summer ploughing in rice based cropping system in heavy soils of eastern India. Technical Bulletin No: R-19/Pat-10, ICAR Research Complex for the Eastern Region. pp 38

- Describes promotion of deep tillage and documents production benefits and levels of adoption
- Provides simple financial analyses of benefit
- Provides evidence of feedback from community

21. *Based on the evidence in the studies listed above, for each country detail how the poor have benefited from the application and/or adoption of the output(s) (max. 500 words):*

- *What positive impacts on livelihoods have been recorded and over what time period have these impacts been observed? These impacts should be recorded against the capital assets (human, social, natural, physical and, financial) of the livelihoods framework;*
- *For whom i.e. which type of person (gender, poverty group (see glossary for definitions) has there been a positive impact;*
- *Indicate the number of people who have realised a positive impact on their livelihood;*
- *Using whatever appropriate indicator was used detail what was the average percentage increase recorded.*

Around 700 farm families benefited directly from different interventions in the project area. The project area comprises of more than 70% resource poor, sharecropper and landless farm families who depend upon income from the farm or wages. The project focused on the extreme poor and socially disadvantaged within this area.

The documents listed above provide evidence of adoption of new agricultural livelihood strategies and project survey respondents reported benefits as including increases income and resource saving and the benefits in terms of improved health & education, food and house-hold items the resource poor.

The poor and socially disadvantaged who had developed their social capital through the activities of R7839 joined dialogues for decision making around water management. An indication of the improved relationships between landless and land owners is reflected in the fact that reports of conflicts in sharing of canal water were reduced from between 2000 and 2005.

Including the voice of the socially disadvantaged was of considerable influence when convincing policy makers of the need to change policy. This resulted in a change in the policy regarding leasing of waterlogged area and improved delivery of canal water.

For those who adopted early crop establishment dates production of rice and wheat yields were more than doubled without increase in inputs. For an investment of Rs. 5000 ha<sup>-1</sup> there was a net gain of Rs. 20,000 ha<sup>-1</sup> (note these figures translate the value of labour used and production to a cash value and do not reflect actual financial return under sharecropping arrangements) however they do provide an indication of significant the net

return and potential benefits.

This increases in net return for involved in crop production, enabled investments in improved cropping practices and more broadly. For example adoption of early transplanting encouraged in an increase in the groundwater market providing an income Rs. 60,000 per year per pumpset to service providers, early recovery of investment and employment generation to unemployed youths in related activities.

This has further opened up a window of opportunity to enhance conjunctive use in the area by use of groundwater for high value crop production and providing capacity for emergency irrigation during dry spells.

Other impacts reported to date include that the number of dropouts in school were reduced, there was more attendance of women in health camp, consumption and sales sale of fruits, vegetable and milk in the local market were increased. Deposits in banks and amounts of credit and demand for credit being for use to support agricultural inputs and other needs were clearly evident (See R7839 impact section).

## Environmental Impact

### **H. Environmental impact**

**24. What are the direct and indirect environmental benefits related to the output(s) and their outcome(s)? (max 300 words)**

*This could include direct benefits from the application of the technology or policy action with local governments or multinational agencies to create environmentally sound policies or programmes. Any supporting and appropriate evidence can be provided in the form of an annex.*

The project deals with the productive use of water, which represents a vital resource, agriculture has considerable potential to deliver environmental benefits by ensuring that both diffuse and direct pollution does not arise, whilst increasing the productive use of the resource.

The project encourages awareness of the benefits of canal seepage in providing affected groundwater recharge, supporting bio-diversity and providing productive opportunities that exist for the use of waterlogged areas.

The opportunity to realise reductions in greenhouse gas emissions per unit agricultural production offers a route to mitigate the effects of climate change.

**25. Are there any adverse environmental impacts related to the output(s) and their outcome(s)? (max 100 words)**

Inappropriate agricultural intensification has considerable potential to contribute to both diffuse and point source pollution.

Groundwater use can lead to depletion of the water table and other issues. However this is an area of high rainfall with significant recharge.

*26. Do the outputs increase the capacity of poor people to cope with the effects of climate change, reduce the risks of natural disasters and increase their resilience? (max 200 words)*

The “broad-based PIM” approach combined with the “dialectic approach” reported by R7839 absolutely increase the capacity to cope with disasters and resilience.

The benefits of enhanced social and financial capital and other assets are recorded by R7839. The ability to draw upon these assets enables individuals and families to cope with such events. The “dialectic-approach” of R7839 has also been shown to provide risk management strategies for individual households.

Increases in production and diversification of agriculture as reported here mean that livelihood strategies are underpinned by a more robust production system offering a coping mechanism and resilience.

The expansion and strengthening of the groundwater market provides a capacity for emergency irrigation that previously did not exist to maintain crops when rains fail or there are failures within the canal delivery system.

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