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Final report

project

Efficient participatory irrigation institutions to support productive and sustainable agriculture in south Asia

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1 Acknowledgments

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We are also thankful to the ACIAR team, particularly Dr Kazmi and Dr Qureshi, who provided invaluable assistance throughout.

Finally, this project would not have been made possible without the generosity of all the households who gave their valuable time towards responding to the lengthy and complex surveys.

2 Executive summary

The project was based in four jurisdictions – the states of Assam and Bihar in India and Sindh and Punjab provinces in Pakistan.

Working closely with the governments of Bihar and Assam in India, along with the Irrigation and Drainage Authorities in Punjab and Sindh in Pakistan, the project team assembled a detailed data set on the performance of participatory irrigation schemes across the four jurisdictions.

The assembled data were subsequently modelled collaboratively with a mixture of Australian, Indian and Pakistani expertise. The statistical models were designed to answer key local questions, like what drives the best performance of participatory irrigation in a given location.

Working beyond the initial brief, the team also assembled unique data comparing the perceptions of men and women, in an environment where gender often dictates who makes particular decisions about water management.

In addition, data were collected on the preferences of farm householders for changes to participatory practices, like how the revenues for irrigation maintenance are raised and used. This element proved particularly challenging, given previous limited opportunities afforded farmers to have a say on the structure of participatory rules.

The results were presented to governments officials in India and Pakistan and the evidence was leveraged to open a dialogue on the best way to take participatory irrigation forward. Exposure visits to Thailand and Australia also occurred, with a view to informing irrigation officials about different options beyond the beneficiary/benefactor relationships that typify farmer/irrigation department interactions in South Asia. The resulting roadmaps generated by the data and the insights gleaned from exposure shows a one size fits all is unlikely to deliver enduring success.

In some cases, state irrigation officials involved in the project gained sufficient support and developed capacity from the project to plan new initiatives aimed at giving additional control to farmers. In other cases the results help guide irrigation departments to reassume responsibilities from farmers that were adjudged to be better managed centrally.

Overall, the project has both highlighted the challenges associated with participatory irrigation and exposed the considerable opportunities. Where devolution of decision making has been approached sincerely and where resources and expertise have been judiciously matched between farmers' and irrigation officials' capabilities, the outcomes have been better. There is also clear evidence that states and provinces cannot simply leave all decision making to farmer groups and localised governance and compliance is most effective when states and provinces continue to support activities with good practices of their own.

3 Background

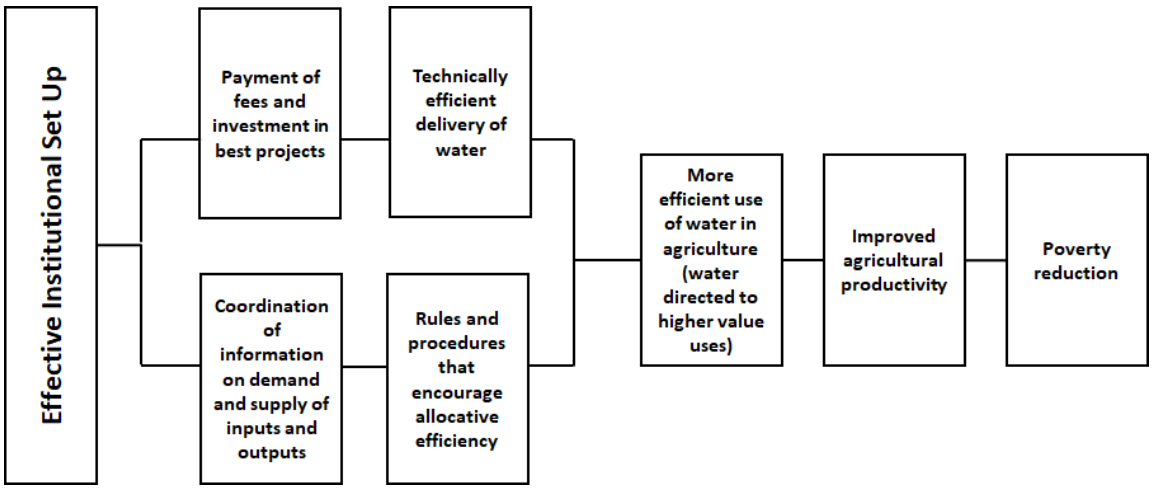
In South Asia institutional weaknesses substantially reduce efficiency in irrigation, and a policy for the sector has emerged that involves devolving decisions to farmers.

Known as Participatory Irrigation Management (PIM) and in some cases Irrigation Management Transfer (IMT), such approaches yield mixed results, especially in East India and Pakistan (Senanayake, Mukherji, & Giordano, 2015). Given the vast sums of money spent on devolving responsibilities and irrigation generally (e.g. Indian Express 2015) it would be preferable to determine the potential gains from PIM/IMT in advance and identify the forms of participation that deliver greatest impacts on irrigation efficiency and poverty reduction.

There is significant potential to increase agricultural production and thereby improve livelihoods in the Indus and Ganges river basins. However, there are major challenges. In Pakistan, for example, rural poverty is endemic, and the potential in the Indus is either unharnessed or misdirected. In the Ganges, which is the most densely populated basin in the world, much of the population is both poor and heavily dependent on agriculture and thus the management of water resources.

As water scarcity intensifies due to an increasing population and the impacts of climate variability, the importance of robust irrigation institutions is paramount. Weak institutions exacerbate bio-physical challenges by allowing the use of scarce resources in relatively unproductive pursuits. This reduces agricultural production and locks rural people into poverty. In contrast, effective institutions can offer a buffer against bio-physical challenges by encouraging water to be used in the most productive ways and by signalling the need for adaptation when scarcity binds (Crase & Gandhi, 2009). These overarching potential relationships are depicted, from an economic perspective, in Figure 3.1.

Figure 3.1. Conceptual relationships between institutional improvement and poverty alleviation



The links between efficient irrigation and poverty reduction have been thoroughly investigated for some time. Food and Agriculture Organisation (FAO) (Hodgson, 2004) note that permanent on-farm and off-farm employment is the main driver of poverty reduction resulting from large-scale irrigation in the developing world. In addition, FAO cite instances where increases in year-round employment due to irrigation were in excess of 90 per cent. Similar evidence was found by Gandhi and Bhamoriya (2009) and this represents a significant welfare improvement, at least to the extent that labour was potentially laying unemployed.

Any gap between potential and actual performance of community irrigation thus needs to be considered. If weak institutions limit the performance of irrigation (as has been widely

established) then it reduces the intensity and profitability of agriculture, which, in turn, constrains employment opportunities and incomes, especially for the rural poor.

Against that background, the general push towards devolving decisions to farmers arose in the 1980s and became a central tenet for most donor agencies thereafter. Whilst there is a distinction between PIM and IMT made in the literature, it is probably more helpful to think of PIM and IMT as existing on a spectrum of devolved 'control' or the assignment of 'management' responsibilities rather that strictly separate phenomena, as also evidenced by the different degrees of devolution found by Gandhi & Namboodiri (2011).

Numerous case analyses on PIM/IMT are reported in the literature (Vermillion, 1997; Braimah, King, & Sulemana, 2014) with most focussing on the impacts on financing, operation and maintenance and agricultural productivity. Overall, there is little conclusive evidence from these studies on the success of devolved decision making or what drives success and this can be attributed to several reasons. First, the context of PIM/IMT is critical but variable, especially the political economy dimension which has not always been captured in comparative empirical analysis. Second, there is seldom a clear 'before' and 'after' against which PIM/IMT can be compared – numerous other changes occur simultaneously making it hard to unbundle the specific effects of irrigation reform. Third, not all forms of PIM/IMT are comparable – some are more modest in their approach and staged, whilst others are comprehensive and achieved quickly.

In the context of the latter it is worth noting that the scale of devolved decision-making is not always consistent across PIM/IMT. Even though the World Bank defines PIM as the involvement of users in "all aspects and at all levels of irrigation" (World Bank, 2007) some states have taken a view that farmer involvement should be limited to smaller reaches of the system whilst others have aimed at wider participation. In part, this is attributable to the agricultural landscape with larger commercial farmers often more willing to be active participants in reform (World Bank, 2007), whilst smallholder PIM/IMT is plagued by higher transaction costs, simply due to the number of participants.

Nevertheless, the key element that ties PIM and IMT together is the overarching presumption that devolved decisions are more efficient in general and simultaneously reduces the financial and managerial burdens on cash-strapped governments (Hamada & Samad, 2011). Whilst theoretical principles like subsidiarity and their relationship to efficiency are well-understood, the practical analyses of PIM/IMT show a varied response. Some successes are claimed in developing countries like Mexico, Colombia and to a lesser extent the Philippines, but even in these cases a range of second-order problems have emerged (World Bank, 2007). Key amongst these is the capacity to permanently secure payments from farmers for water delivery and the vicious cycle between under-recovery of costs, faulty infrastructure and poor service.

Given that one of the primary motivations for promoting PIM and IMT has been the need to enhance cost recovery, this raises serious questions about the efficacy of the devolution approach more generally. This project sought to tackle this issue directly by recasting the way we think about PIM/IMT – namely, as a 'horses for courses' way of increasing the efficiency of communal irrigation rather than as a 'one size fits all' phenomenon.

4 Objectives

4.1 Aims

The project's overarching aim was to improve the analytical skills and understanding of policy makers and irrigation officials, specifically as they relate to PIM/IMT.

The aims of the project were to:

- establish the relative efficiency of different types of devolved decision-making to farmers and identify how this varied in different settings
- develop new methods to estimate the magnitude of improvements from PIM/IMT and link this information to factors that could be observed beforehand.

Ultimately, this work aimed to benefit the poor by striking a better balance between centralised/decentralised decision-making. This was expected to manifest in improvements in the reliability of water delivery, thereby intensifying production by smallholders, while impacting employment for the landless and potentially changing the empowerment of women.

4.2 Project objectives

The project took four years and had four objectives:

1. Improve policy makers' understanding of farmers' experiences of PIM/IMT.
2. Enhance understanding of what motivates farmers to pay irrigation fees and participate in irrigation upgrades.
3. Identify the key influences of successful devolution at different scales and in different settings.
4. Engage policy makers in a critical discourse about the usefulness of different forms of PIM/IMT at different scales and in specific locations.

As a result of the initial case materials collected in 2016-17, a dedicated examination of gender issues was adjudged to be warranted. This was in addition to the analysis initially intended. At this point it was also adjudged useful to directly elicit the preferences of farmers for changes to PIM.

Survey instruments were subsequently developed to cover the initial topics of interest and other elements identified in the case phase (namely extra gender analysis and the discrete choice experiments). The survey instruments were piloted in early 2018 mostly in India, where the onset of the monsoon was more pressing, before full deployment later in the year. Analysis and dissemination occupied the remaining time allocated to the project.

4.3 Research questions and approach

In partnership with local policy makers and irrigation officials, the project addressed several questions:

- What is the empirical evidence on the performance of PIM/IMT, based on data collected from farmers?
- Is successful PIM/IMT tied to existing institutional, geophysical, socioeconomic or agricultural factors that are observable in advance?
- What are the potential improvements through PIM/IMT in specific locations and what is most important to achieving these gains?

- What is the potential of PIM/IMT to influence cost recovery and participation in investment upgrades and is that potential measurable in advance?
- Collectively, what does this information tell policy makers about the likely benefits of PIM/IMT at different scales and how can public investment in irrigation institutions be better targeted?

5 Methodology

5.1 Activity Categories

As noted, there were four objectives for this project. The activities designed to help achieve the project's objectives, were divided into four main categories:

1. Measuring the experiences of PIM/IMT and modelling perceived performance using transaction cost analysis.
2. Compliance analysis and participation in infrastructure upgrades.
3. Modelling water management under PIM/IMT versus centralised management.
4. Engagement and communication (overarching).

The project methodology is discussed in relation to these four categories.

The detailed methodology employed at different study sites and in each country is documented in open access papers. See Table 7.2.1.1 for paper details.

1. Measuring the experiences of PIM/IMT and modelling perceived performance using transaction cost analysis

The transaction cost approach pioneered in the ACIAR project ADP/2001/014 and later refined in another ACIAR project LWR/2006/158 was reconfigured, updated and extended for use in Assam, Bihar, Punjab, and Sindh. The project team used the data from these earlier projects to establish benchmark comparisons of successful devolution in other states such as Andhra Pradesh and Gujarat. The empirical constructs used are summarised with the conceptual framework for institutional elements and sub-elements in water management (Figure 5.1.1). The basic rationale is that each of these constructs has some bearing on irrigation performance, but the relative impact varies and is complicated by interactions.

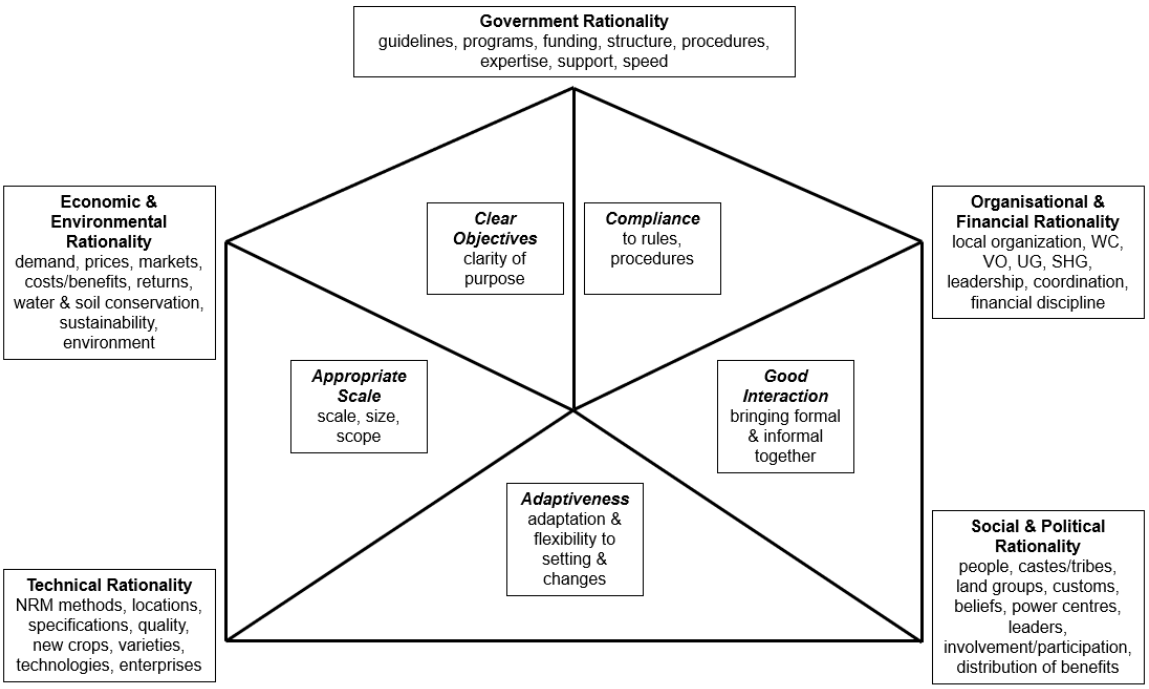
This approach is suited to measuring the performance of irrigation at the village or Water Users Association (WUA) or Farmer Organisation (FO) scale.

To ensure that the framework was still applicable in the four settings, extensive case analysis was first undertaken to establish the on-ground realities. The findings from case studies were cross-checked with irrigation officials and other NGOs involved. A literature review of pertinent reforms and their impacts by jurisdiction was also used here.

The primary data collected also covered several dimensions of performance and the perception that water was delivered more effectively. A key point was to understand how effective water delivery and management changed with different institutional set-ups and then subsequently impact on agricultural production.

The different measures of performance were analysed separately as well as collectively. In some cases, the point of comparison for individual households (i.e. counterfactual) was centralised arrangements but this was not always the case. For example, some study sites offered a range of 'starting' and 'finishing' points and this was an important contribution offered by the reference groups who tried to provide a diverse sample of organisational structures.

Figure 5.1.1. Conceptual framework, water management, institutional elements and sub-elements



The Indian Institute of Management Ahmedabad (IIM) was responsible for coordinating this part of the work in collaboration with the University of Agriculture in Punjab, Institute of Water Resources Engineering and Management in Sindh, and the Council on Energy, Environment and Water in Bihar. The Government of Assam (GoA), Government of Bihar (GoB), Punjab Irrigation Drainage Authority (PIDA) and Sindh Irrigation Drainage Authority (SIDA) were directly involved in the research. Agencies assisted with introductions to study sites, although a sampling frame to ensure full representation was administered by the research team.

The process involved:

1. structured interviews to refine and tailor each of the elements to the study sites accompanied by a review of grey and academic literature
2. iterative development (with input from irrigation officials) and then deployment of a large-scale survey instrument covering approximately 250 households per jurisdiction across multiple sites (head, middle, tail) – this measured each component in the framework using multiple survey items
3. statistical analysis to produce specific performance indicators.

The first step in his process revealed an opportunity to investigate the variable impact and views of PIM between men and women, More specifically, the interviews, literature review and case studies raised questions about how the benefits of PIM to women had been conceptualised in legislative fora and how it played out in practice. A major effort was thus put into designing a modified version of the women's empowerment index and relating it to the institutional survey.

In addition, the development phase for the survey revealed an issue around how farmers conceptualised their power over shaping the rules. With that in mind an additional element

was added to the original plan. This involved developing a choice experiment that would attempt to elicit different preferences around institutional design. The intention with this component was to use tablet data collection and thus help build the skill base of partners.

The third step in the process involved several statistical techniques including factor analysis (to reduce the various item responses to manageable and reliable scores), multiple regressions and structural equation modelling (SEM). The advantage of SEM is that it can take into account feedback effects across the different institutional elements and performance indicators or rationalities.

Unpacking the institutional elements in Assam, Bihar, Punjab and Sindh along these lines enabled us to empirically test which components of the institutional set-up were more heavily correlated to improvements in performance. We used the jurisdictional data both separately and pooled to investigate the key drivers of performance. The reference groups were used to pose questions that were interrogated within these data and also challenge the resulting empirics. The models were integrated with the information that comes from the more detailed analysis of compliance and participation and again this directly involved the reference groups. The results were also 'road-tested' at different points with senior bureaucrats; this was done to ensure engagement with the final dissemination as well as providing capacity to decision makers.

To reiterate, the focus for this part of the analysis was experiences at the WUA/village level. The initial structured interactions involved irrigation officials at all levels. Thus, this part of the project provided valuable insights to support the other two elements of the research: compliance analysis and modelling of how higher-level decision making interacted with farmer choices.

2. Compliance analysis and participation in infrastructure upgrades

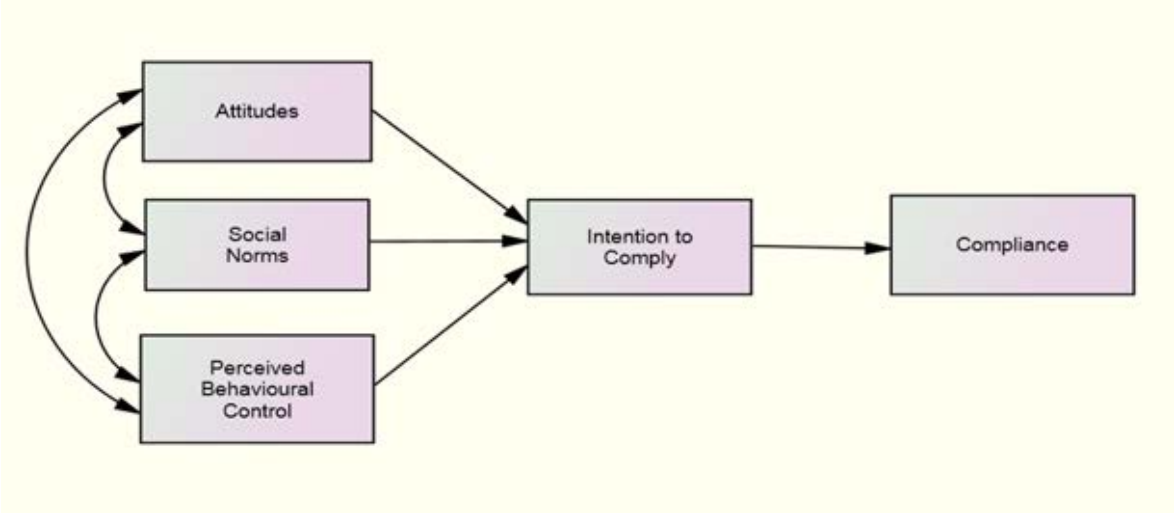
The aim of this activity was to investigate two different motivations, the willingness:

- to comply and intentions to comply
- to participate in irrigation upgrades and intentions to participate.

A key tenet of PIM/IMT is that collection of irrigation fees is greater under a decentralised arrangement, and participation in capital programs and adherence to water distribution rules also improves. Collectively, these components are important to the technical efficiency of irrigation since (a) payment of charges underpins adequate operation and maintenance and (b) optimising physical infrastructure directly affects production.

Cooper (2010) identified that actual compliance behaviour in most settings is a composite of multiple drivers. Cooper also identified ways of measuring compliance and intentions to comply along each of the dimensions suggested by the theory of planned behaviour and as illustrated in Figure 5.1.2.

Figure 5.1.2. Framework, compliance drivers



Primary data was collected from each jurisdiction and this was used to empirically estimate compliance intentions and motivations. By applying similar measures to study locations in Assam, Bihar, Punjab and Sindh, we were able to unbundle and establish ex ante variables that influence (or predict) compliance (e.g. the payment of irrigation fees) and the motivations that sit behind those behaviours. We were able to compare this against data on compliance by asking respondents to estimate the rate of compliance of neighbours.

The involvement of the reference group allowed us to thoroughly test these empirical results and investigate specific questions of interest to stakeholders. Guided by members of the policy and practitioner communities, compliance and participation behaviour were related statistically to two things: (1) the institutional apparatus in different WUA/village; and (2) other observable factors (e.g. locational variables; agronomic variables etc.). This was to help policy makers predict the technical success of PIM/IMT in advance.

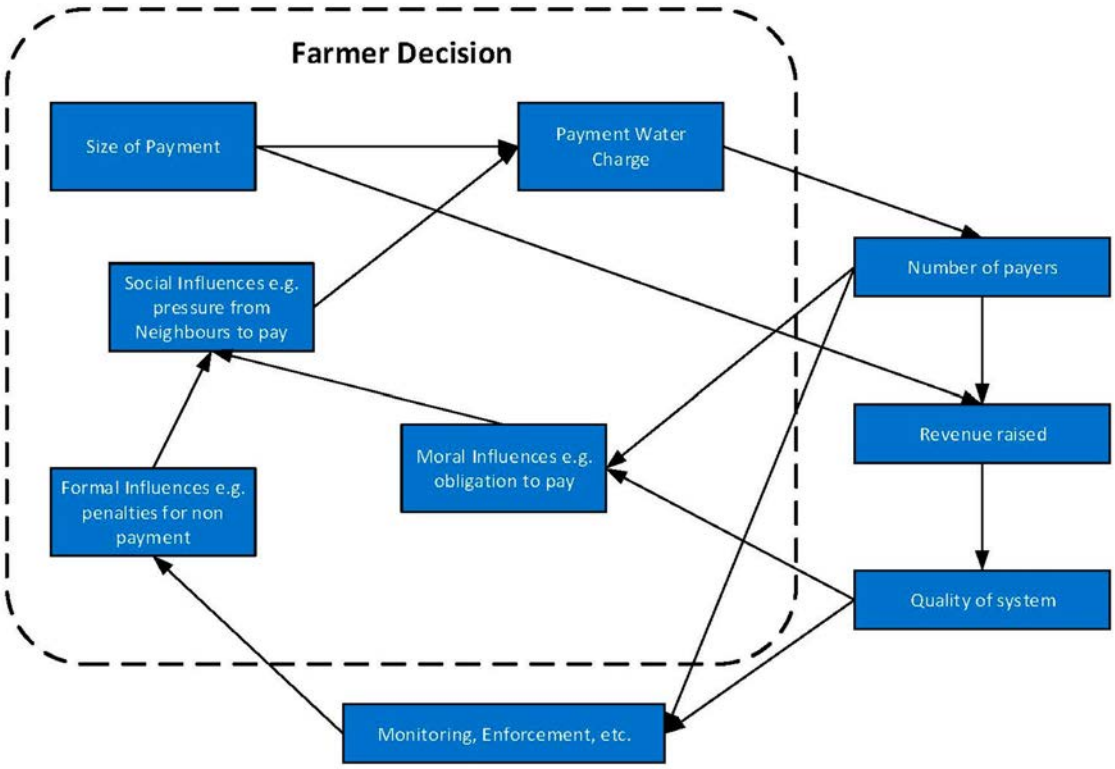
Researchers from the University of South Australia (UniSA) led this component in partnership with IIM and Council on Energy, Environment and Water (CEEW) in Assam/Bihar. GoA and GoB also actively participated and assisted. PIDA and SIDA were also involved. Broad collaboration with New York University and University of Adelaide assisted in this component.

3. Modelling water management under PIM/IMT versus centralised management

Water management can be problematic because of the fugitive nature of the resource (without a fixed location) and the fact that choices in one part of a system necessarily impact on other parts. The interaction between choices makes cooperation or the lack of it critical to success. The purpose of developing a model about choices was to systematically analyse different decisions within the context of plausible assumptions; such as where local agents have more local control over decisions or spending choices or where the compliance regimes are administered locally.

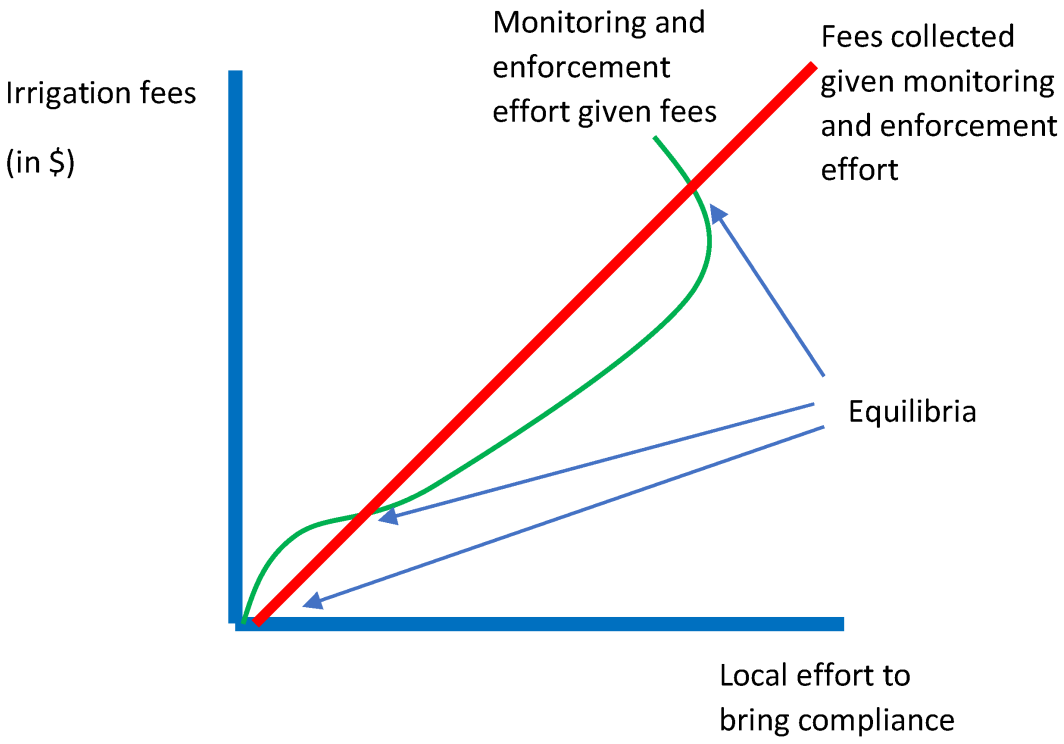
Drawing on the input from the research participants, state/provincial agencies and the numerous case analyses, a conceptual model that captured the complexity of cooperative farmer behaviour emerged. This model drew directly from a review of the application of game theory to irrigation, although studies were relatively rare. The resulting analytical framework that is in displayed in Figure 5.1.3.

Figure 5.1.3. Analytical framework



This model was subsequently used to contemplate the prospect of at least two equilibria representing cooperative and non-cooperative outcomes (see Figure 5.1.4).

Figure 5.1.4. Cooperative and non-cooperative outcomes



The idea was to map these different equilibria against different incentives, like those that relate to retaining collected fees locally and those that attend bringing compliance to neighbouring farmers. Survey data would be used to better understand how PIM performed better (or worse) when different functions were assigned to local authorities. In simple terms, this approach would ideally illuminate the extent to which assigning different types of authority to local farmers could shift the outcome from an non-cooperative equilibrium seen in the lower left of Figure 5.1.4 (i.e. vicious cycle of low payment and poor compliance-poor performance-low productivity-low payment and poor compliance) to a cooperative outcome (virtuous cycle).

4. Engagement and communication

Engagement and communication were critical to both the delivery and the impact of this project, so they were infused into all the activities. The delivery agencies responsible for PIM in each jurisdiction were directly involved at all stages, although care was taken to ensure the data were objectively assembled and analysed. In some cases agencies were assigned a budget to defray costs of data collection and the time of their input. This also assisted in supporting exposure and capacity building activities. These agencies also provided a sounding board at different points and simultaneously facilitated access to influential decision makers, like Ministers and Secretaries of irrigation departments. This involvement allowed continuous monitoring and measuring of progress and facilitated evaluation during the final discussion phase of the project.

The method of engagement was tiered. The lead in-country partners (IIM and PARC) met with the agencies on at least a monthly basis to update and gain feedback. Other partners (e.g. MUET and UoAF) met with similar frequency with specific jurisdictions to maintain momentum. Six-monthly updates were provided by the overall team and annual whole-of-team meetings that included delivery agencies occurred.

These meetings afforded the opportunity for cross-jurisdictional dialogue and a sharing of lessons about PIM between Indian and Pakistan agencies.

5.2 Phases & activities

The project was carried out in phases and multiple activities were in progress simultaneously in each phase. The activities in Table 5.2.1 align with the activities listed in the Objectives tables in Section 6.

Table 5.2.1. Project activities by phases

Category	Phase	Activity
1	Pre-phase	Assemble separate Pakistan and Indian reference groups along lines outlined in proposal
	Pre-phase 1a	Establish terms of reference for each group including communication protocols
	Pre-phase 1b	Collaboratively formulate work plan and workflow between project advisory committee, reference groups, execution committee and the Australian Water Partnership (and others)
	Pre-phase 1c	Identify appropriate study sites and ratify, with majority support of reference groups. Six case sites in total with one designated as Hakra in Punjab.
	Pre-phase 2a	Assemble data on the institutional set up that applies at each case site, including mapping of protocols that relate to compliance and participation in infrastructure upgrades.
	Pre-phase 2b	Assemble data on linkages between institutions at lower levels of the hierarchy and those at higher levels. This includes formal and informal links.

Category	Phase	Activity
	Pre-phase 2c	Identify key parameters of interest to members of the reference groups in the context of devolved decision making – i.e. what do members see as the major factors that promote (detract) from efficient devolution?
2	1	Using existing surveys instruments on institutional performance as a starting point, design and tailored survey on institutional performance for Punjab, Sindh and Bihar. This relates to WUA and village scale.
	2	Administer survey instrument across the four jurisdictions in-person to circa 250 households per jurisdiction.
	3	Develop empirical models that link institutional performance (measured across different dimensions – efficiency, equity and environmental sustainability) with institutional characteristics and other tangible 'markers' using (1) jurisdiction-specific data (2) pooled data.
	4	Refine empirical models using Structural Equation Modelling or similar and explore specific questions about local institutions and the related setting as raised by reference groups.
	5	Integrate findings from models of institutional performance, compliance and participation in irrigation upgrades at village/WUA level and report key findings.
	Final	Sponsor and promote outreach and engagement activities and assist policy makers to scrutinise the merits of different forms of devolved decision-making in different contexts. (Activities from Objective 4, Section 6.)
3	1	Using existing surveys instruments on compliance and participation as a starting point, design and tailored survey on compliance and participation for Punjab, Sindh and Bihar. This relates to WUA and village scale.
	2a	Collect primary data on motivations to comply and intentions to comply using in-person surveys administered to circa 250 households per jurisdiction.
	2b	Collect primary data on motivations to participate in irrigation upgrades and intentions to participate using in-person surveys administered to circa 250 households per jurisdiction.
	3a	Develop empirical models that explore linkages between compliance and other 'markers' using (1) jurisdiction-specific data (2) pooled data.
	3b	Develop empirical models that explore linkages between participation in irrigation upgrades and other 'markers' using (1) jurisdiction-specific data (2) pooled data.
	4	Integrate models on compliance and participation to investigate specific queries raised by reference groups.
	5	Integrate findings from models of institutional performance, compliance and participation in irrigation upgrades at village/WUA level and report key findings.
	Final	Sponsor and promote outreach and engagement activities and assist policy makers to scrutinise the merits of different forms of devolved decision-making in different contexts. (Activities from Objective 4, Section 6.)
4	1	Construct a robust model that considers the impact on economic efficiency from alternative forms of control, cooperation and devolution at the main canal scale.
	2	Using results from activity groups 2 and 3 (phase 5) test and explore the impacts on economic efficiency at main canal level given different settings and starting points at the village/WUA level.
	Final	Sponsor and promote outreach and engagement activities and assist policy makers to scrutinise the merits of different forms of devolved decision-making in different contexts. (Activities from Objective 4, Section 6.)

5.3 Roles & responsibilities

The assignment of roles for collaborators is summarised in Table 5.3.1.

Table 5.3.1. Roles and responsibilities by activity group

Province/ State	1. Transaction cost analysis	2. Compliance and participation analysis	3. Modelling of management choices	4. Engagement and communication
Sindh	IIM; IWREM; SIDA	UniSA; University of Adelaide; NYU; UoK; SIDA	UniSA; NYU; PIDE; PARC; SIDA	PARC; SIDA; UniSA; University of Adelaide; NYU; UoK; PIDE; IIM; IWREM
Punjab	IIM; UoAF; PIDA	UniSA; NYU; UoAF; University of Adelaide; PIDA	UniSA; NYU; PIDE; PARC; PIDA	PARC; PIDA; UniSA; NYU; UoAF; University of Adelaide PIDE; IIM
Bihar	IIM; CEEW; GoB	UniSA; IIM; CEEW; University of Adelaide; GoB	UniSA; IIM; CEEW; GoB	IIM; GoB; CCEW; UniSA; University of Adelaide
Assam	IIM; CEEW; AID	UniSA; IIM; CEEW; University of Adelaide; AID	UniSA; IIM; CEEW; AID	IIM; AID; CCEW; UniSA; University of Adelaide

In broad terms IIM was central to the management of the project in India. Pakistan Agricultural Research Council (PARC) played the key coordinating role in Pakistan. Most of the primary data collection was done by IIM in India, although some assistance was contracted.

In Pakistan, data collection was done by the Institute of Water Resources Engineering & Management (IWREN) at MUET and University of Agriculture Faisalabad (UoAF), depending on location. University of Karachi (UoK) and Pakistan Institute of Development Economics (PIDE) provided specialised intellectual inputs at various points, whilst PIDA and SIDA offered the on-ground knowledge in Pakistan.

On-ground expertise and experience in India came from GoB and Assam Irrigation Department (AID) whilst specialist services were provided by CEEW. Of the Australian partners, UniSA played the lead role in terms of guiding most elements of the work, whilst University of Adelaide offered particular service and skills pertaining to some of the gender analysis. New York University also provided input on some components and UWA provided in-kind assistance with statistical modelling.

All exposure visits were arranged by UniSA. This included viewing different partnering arrangements between irrigators and irrigation departments in Thailand and the customer-provider relationship that attend irrigation activities in Australia.

5.4 Summary

Collectively, the research activities were systematically divided into groups of activities targeted at the different research objectives. After the initial investigations two additional components were added to increase the richness of the data for decision making. These related to gender-driven aspects of performance of PIM and elicitation of preference for changing PIM arrangements.

Ultimately, the data were intended to provide robust evidence-based advice about where and when PIM/IMT can deliver gains.

The multiple data sets are a rich source for future studies that go beyond the findings published in the refereed open access papers already assembled and listed in Table 7.2.1.1.

6 Achievements against activities and outputs/milestones

Objective 1: Improve policy makers' understanding of farmers' experiences of PIM/IMT in Assam, Bihar, Punjab and Sindh.

No.	Activity	Outputs/ milestones	Completion date	Comments
1.1	Assemble separate Pakistan and Indian reference groups along lines outlined in proposal. (PC; A)	Project inception meetings conducted in both countries and joint meeting with at least 80% attendance.	January 2017	Reference groups in Pakistan and India met and remained involved in the project. The Indian reference group was officially commissioned in August 2016. The launch of several water-related projects in Pakistan in late January 2017 was used to officially raise profile of the project and to engage reference members from Pakistan on an official basis.
	Establish terms of reference for each group including communication protocols. (PC; A)	ToR published and agreed for each reference group. Commitments to meeting schedules and participation secured.	2017	The role of the reference groups was agreed and documented.
	Collaboratively formulate work plan and workflow between project advisory committee, reference groups, execution committee and the Australian Water Partnership (and others). (PC; A)	Gantt charts completed for each activity category. Protocols for communication between two country reference groups and between Australian policy makers agreed and published.	2017	Work plans were initially established and updated at meetings in Sri Lanka, Thailand and Australia. It proved difficult to arrange joint meetings in person with travel restrictions imposed on some advisory group members. Skype, other communication, the work plan in-country was negotiated and accepted by participants. Each of the participating institutions set deliverables. The engagement with AWP was limited by some adjustments to leadership within AWP. The Project Leader met with DFAT and also engaged with ACIAR's SDIP work in India. Communication with the regional office of FAO continued to ensure alignment with other international work. In July 2019 additional engagement with DFAT was initiated in line with the MoU on water between Pakistan and Australia. In 2020 a webinar was arranged to help ACIAR map and promote additional work.

No.	Activity	Outputs/ milestones	Completion date	Comments
	Identify appropriate study sites and ratify, with majority support of reference groups. Eight case sites in total with one designated as Hakra in Punjab. (PC; A)	Study sites listed and their geographic and social scope documented.	2017	The diversity witnessed in some jurisdictions and the enthusiasm of local managers resulted in an expansion of case sites. In the case of Sindh some sites were not pursued for data collection due to push-back from local farmers.
1.2	Assemble data on the institutional set up that applies at each case site, including mapping of protocols that relate to compliance and participation in infrastructure upgrades. (PC: A).	Report that maps the institutional set-up at each study site as it stands and presents a synopsis of development.	September 2017	Six case studies and several site comparison papers were developed. Presentations describing policy environment and institutional settings of each state/province were developed and short reports on each study site were presented at the synthesis meeting in September 2017.
	Assemble data on linkages between institutions at lower levels of the hierarchy and those at higher levels. This includes formal and informal links. (PC; A) Qualitative interviews with stakeholders involved in institutional design. (PC)	Report that details the relationship between the institutions operating at each case site and the relationships between higher authorities.	September 2017	Short reports on each study site were presented at the synthesis meeting in September 2017.
	Identify key parameters of interest to members of the reference groups in the context of devolved decision making – i.e. what do members see as the major factors that promote (detract) from efficient devolution? (PC; A)	Short report detailing *a priori* expectations of markers from stakeholders (and for future monitoring and evaluation exercises).	July 2018	Building on the cases, a presentation considering the interplay between retention of control and decision-making using game theory was completed and presented at the mid-project review in July 2018. The model was subsequently parameterised and published in *Water* (see Table 7.2.1.1). It also emerged that gender should be a key consideration and that farmer preferences for change deserved specific attention.
1.3	Using existing survey instruments on institutional performance as a starting point, design and tailor survey on institutional performance for Punjab, Sindh and Bihar. This relates to WUA and village scale. (PC; A) Pilot survey and refine to meet needs of survey participants. (PC)	Site-specific surveys ready for deployment that can measure institutional performance on different dimensions.	April 2018	Additional gender elements added and discrete choice component designed
1.4	Administer survey instrument across the four jurisdictions in-person to circa 250 households per jurisdiction. (PC)	Data set of farm households' experiences with PIM/IMT	August 2018	Paper and tablet versions were ultimately required

No.	Activity	Outputs/ milestones	Completion date	Comments
	Develop empirical models that link institutional performance (measured across different dimensions – efficiency, equity and environmental sustainability) with institutional characteristics and other tangible 'markers' using (1) jurisdiction-specific data and (2) pooled data. (PC; A)	Data from survey inputted and cleansed. Factor analysis completed and published. Basic empirical models linking performance formulated and tested. Pooled and un-pooled models reported. Meetings with reference groups completed with tests of initial markers against performance and exploration of additional markers.	June 2019	Models were completed and reviewed for publication.
	Refine empirical models using Structural Equation Modelling or similar and explore specific questions about local institutions and the related setting as raised by reference groups. (PC; A)	SEM models developed and published. Meetings with reference groups completed and documented to present and test ideas for alternative empirical models of performance.	June 2019	Structural Equation Models were developed, reviewed and published.
1.5	Integrate findings from models of institutional performance, compliance and participation in irrigation upgrades at village/WUA level and report key findings. (PC; A)	Synoptic report that compares best-fitting empirical models on institutional performance with best-fitting compliance and participation models. Meeting of reference groups to present and challenge findings. Follow-up report that details views of reference groups in context of findings from activity category 2.	July 2020 September 2019	An integrated policy message was refined in preparation for the dissemination work in Pakistan and India. This formed the basis of presentations in all four jurisdictions An integrated policy message was refined in preparation for the dissemination work in India.

PC = partner country, A = Australia

Objective 2: Enhance understanding of what motivates farmers to pay irrigation fees and participate in irrigation upgrades in these regions.

No.	Activity	Outputs/ milestones	Completion date	Comments
1.2-1.5	Activities 1.2 – 1.5 also inform this objective but are not repeated here to avoid confusion.			
2.1	Using existing survey instruments on compliance and participation as a starting point, design and tailored survey on compliance and participation for Punjab, Sindh and Bihar. This relates to WUA and village scale. (PC; A) Pilot survey and refine to meet needs of survey participants. (PC)	Site-specific surveys ready for deployment that can measure institutional performance on different dimensions.	April 2018	Completed simultaneously with the institutional survey
2.2	Collect primary data on motivations to comply and intentions to comply using in-person surveys administered to circa 250 households per jurisdiction. (PC)	Data set of compliance motivations and behaviours.	August 2018	Completed simultaneously with the institutional survey. This was also ratified by additional questions at the start of the DCE survey on tablets
2.3	Collect primary data on motivations to participate in irrigation upgrades and intentions to participate using in-person surveys administered to circa 250 households per jurisdiction. (PC)	Data set of motivations and behaviours in context of irrigation upgrades.	August 2018	Completed simultaneously with the institutional survey.
2.4	Develop empirical models that explore linkages between compliance and other 'markers' using (1) jurisdiction-specific data and (2) pooled data. (PC; A)	Data from survey inputted and cleansed. Factor analysis completed and published. Basic empirical models linking compliance formulated and tested. Pooled and un-pooled models reported. Meetings with reference groups completed with tests of initial markers against compliance and exploration of additional markers.	June 2019	Ultimately this required integration of several data sets but the results proved statistically robust

No.	Activity	Outputs/ milestones	Completion date	Comments
2.5	Develop empirical models that explore linkages between participation in irrigation upgrades and other 'markers' using (1) jurisdiction-specific data and (2) pooled data. (PC; A)	Data from survey inputted and cleansed. Factor analysis completed and published. Basic empirical models linking participation formulated and tested. Pooled and un-pooled models reported. Meetings with reference groups completed with tests of initial markers against participation and exploration of additional markers.	June 2019	The models were more robust when developed around broader notions of compliance rather than infrastructure alone – analysis was thus focussed on this broader idea of compliance with WUA/FO rules.
2.6	Integrate models on compliance and participation to investigate specific queries raised by reference groups. (PC; A)	Integrated models developed and published. Meetings with reference groups completed and documented to present and test ideas for alternative empirical models of compliance and participation.	July 2019 September 2019	An integrated policy message was refined in preparation for the dissemination work in Pakistan. An integrated policy message was refined in preparation for the dissemination work in India.

PC = partner country, A = Australia

Objective 3: Identify the key influences of successful devolution at different scales and in different settings.

No.	Activity	Outputs/ milestones	Completion date	Comments
1.2-1.5	Activities 1.2 – 1.5 also inform this objective but are not repeated here to avoid confusion.			
3.1	Construct a robust model that considers the impact on economic efficiency from alternative forms of control, cooperation and devolution at the main canal scale. (PC; A)	Published paper that details inferred relationships between efficiency and level of control and collaboration. Report to reference group showing population of theoretical model with information gained from secondary data.	July 2020 June 2018	A draft paper that uses game theory and information from regional cases was developed. This was presented at the mid-project review in July 2018. Subsequently peer reviewed and published in *Water* (see Table 7.2.1.1). The model was reported at multiple forums including workshops in Pakistan, Thailand and Australia. In its final iteration it was populated by data collected from the DCE work.
3.2 & 3.3	Using results from activity category 2 and 3 (phase 5) test and explore the impacts on economic efficiency at main canal level given different settings and starting points at the village/WUA level. (PC; A)	Report that shows calibration of model and tests scenarios drawn from primary data collected from activity category 2 and 3. Meetings with reference groups completed and documented such that it informs a publication showing the application of the model.	July 2020 September 2019	An integrated policy message was refined in preparation for the dissemination work in Pakistan. An integrated policy message was refined in preparation for the dissemination work in India.

PC = partner country, A = Australia

Objective 4: Engage policy makers in a critical discourse about the usefulness of different forms of PIM/IMT at different scales and in specific locations.

No.	Activity	Outputs/ milestones	Completion date	Comments
1.2-1.5	Activities 1.2 – 1.5 also inform this objective but are not repeated here to avoid confusion. These 'pre-phase' activities are nonetheless important for engaging stakeholders			
4.1	Consult reference groups to help shape survey of institutional performance (activity category 2, phase 1). (PC; A)	Site-specific surveys ready for deployment.	September 2017	Meetings were held in November 2016. On-going meetings with state and provincial end users where Gandhi and Bashir met on a regular basis with end user governments. This activity was finalised at a synthesis meeting in Sri Lanka in September 2017.
	Consult reference groups to help shape surveys of compliance and participation in upgrades (activity category 3, phase 1). (PC; A)	Site-specific surveys ready for deployment.	September 2017	Completed at synthesis meeting in Sri Lanka in September 2017.
	Consult reference groups to help shape model on the trade-offs between cooperation and control (activity category 4, phase 1). (PC; A)	Published paper that details inferred relationships between efficiency and level of control and collaboration.	September 2017	Completed at synthesis meeting in Sri Lanka in September 2017.
4.2	Consult reference groups during empirical model development of institutional performance. (PC;A)	Meetings with reference groups completed with tests of initial markers.	February 2019	Preliminary findings presented at Thailand workshop (November 2018). Refinements were presented at AARES conference symposium in Melbourne, Australia (February 2019).
	Consult reference groups during empirical model development of compliance. (PC; A)	Meetings with reference groups completed with tests of initial markers.	February 2019	Preliminary findings presented at Thailand workshop (November 2018). Refinements were presented at AARES conference symposium in Melbourne, Australia (February 2019).
	Consult reference groups during empirical model development of participation in infrastructure upgrades. (PC; A)	Meetings with reference groups completed with tests of initial markers.	February 2019	Preliminary findings presented at Thailand workshop (November 2018). Refinements were presented at AARES conference symposium in Melbourne, Australia (February 2019).
	Consult reference groups during analysis of institutional performance. (PC; A)	Meetings with reference groups completed and documented to present and test ideas for alternative empirical models.	February 2019	Preliminary findings presented at Thailand workshop (November 2018). Refinements were presented at AARES conference symposium in Melbourne, Australia (February 2019).

No.	Activity	Outputs/ milestones	Completion date	Comments
	Consult reference groups during analysis of compliance. (PC;A)	Meetings with reference groups completed and documented to present and test ideas for alternative empirical models.	February 2019	Preliminary findings presented at Thailand workshop (November 2018). Refinements were presented at AARES conference symposium in Melbourne, Australia (February 2019).
	Consult reference groups during analysis of participation in infrastructure upgrades. (PC;A)	Meetings with reference groups completed and documented to present and test ideas for alternative empirical models.	February 2019	Preliminary findings presented at Thailand workshop (November 2018). Refinements were presented at AARES conference symposium in Melbourne, Australia (February 2019).
4.2	Consult reference groups on integration of findings from models of institutional performance, compliance and participation in irrigation upgrades. (PC; A)	Meeting of reference groups to present and challenge findings. Follow-up report that details views of reference groups in context of findings.	July 2019 September 2019	An integrated policy message was refined in preparation for the dissemination work in Pakistan. An integrated policy message was refined in preparation for the dissemination work in India.
	Consult reference groups to explore changes to cooperation /control model with information from other activity categories. (PC;A)	Meetings with reference groups completed and documented such that it informs a publication showing the application of the model.	July 2019	An integrated policy message was refined in preparation for the dissemination work in Pakistan. This was further developed and honed for Indian end users.
	Sponsor and promote outreach and engagement activities that draw directly on activity categories 2, 3 and 4 and assist policy makers to scrutinise the merits of different forms of devolved decision-making in different contexts.	Forum/ Workshop of policy and practitioner communities. Forum to coincide with mid-term review. Forum to coincide with final review. Summary briefing papers to coincide with reference group meetings. Visits to Australian field sites by members of reference groups. Reciprocal visits between Pakistan and Indian reference groups to selected sites.	August 2020	An integrated policy message was refined in preparation for the dissemination work in Pakistan. An integrated policy message was refined in preparation for the dissemination work in India.

No.	Activity	Outputs/ milestones	Completion date	Comments
4.3	Apply a measuring monitoring and evaluation framework to highlight extent of benefits from reform i.e. MERI Framework. (PC; A)	Project inception meeting. 6 monthly meetings of country reference groups. Annual meetings of country reference groups. Mid-project review Final review.	October 2019	Planning completed. A facilitated 3-day stakeholder workshop was undertaken in Islamabad to ensure alignment with the Pakistan component of the work. In addition, the project in Pakistan supported the Pakistan Food and Agriculture Expo as a means of engaging more broadly in Pakistan. An additional Pakistan-wide event is scheduled for September 2018. Another took place in July 2019. PIDA and SIDA were identified as the key end users in the plan, as were GoA and GoB. The former two were integrated from inception and played a role in all aspects of the work. GoA and GoB were key participants in all workshops and were regularly updated. Officials from both departments were also active in the field exposure offshore and carried important messages to Ministers. The final review was completed in July 2020.

PC = partner country, A = Australia

7 Key results and discussion

In addition to the information provided in this section and the former section on detailed research methodology, additional findings are published at length in a special issue of the journal *Water* titled 'Using Applied Economics to Study Participatory Irrigation institutions and their Impact in South Asia'. A list of the open access papers and a link to each publication are provided in Table 7.2.1.1. The papers are also in the process of being published as a book manuscript at the request of the publisher.

7.1 Summary

Following extensive qualitative phases comprising numerous detailed interviews, focus sessions and case studies, over 1,050 surveys were deployed to households in Bihar and Assam in India and Punjab and Sindh in Pakistan. The surveys were primarily aimed at measuring the performance of PIM against a range of discernible influences. Amongst others, the survey instruments covered institutional components of water management, irrigation performance measures, compliance behaviour, the views of different genders, and the preferences for change.

Figure 7.1.1. Finalisation of data collection in Sindh, including gender survey

Figure 7.1.2. Jointly managed irrigation networks, Sindh

Figure 7.1.3. Jointly managed channel systems, Sindh

The project team worked closely with the governments of Assam and Bihar, and the Irrigation and Drainage Authorities in Punjab and Sindh to assemble these data, in part to illustrate how evidence might support decisions about future changes.

In Assam and Bihar workshops were attended by top government officials including the Assam Irrigation Minister (see Figure 7.1.4) and the water Resources Minister in Bihar see Figure 7.1.5).

Figure 7.1.4. Minister for Irrigation and Professor Gandhi, Assam, September 2019

Figure 7.1.5. Water Resources Minister performs lighting ceremony, Bihar, September 2019

Figure 7.1.6. Minister for Irrigation Punjab, Professor Crase and Dr Bashir, Lahore, July 2019

Engaging with the governments and authorities in both countries enabled the crucial discourse about the usefulness of different forms of PIM/IMT at different scales and in specific locations. It also provided an opportunity to help inform the options for policy makers. In particular, the data helped to challenge the perceptions about farmers acceptance of different elements of PIM and the role of the state in supporting PIM.

The assembled data from the surveys were modelled collaboratively with a mixture of Australian, Indian and Pakistani expertise. The statistical models were designed to answer key local questions, like what drives the best performance of participatory irrigation in a given location and how could improvements be fostered. This was achieved by using a structured interactive approach with those responsible for the roll-out of PIM and relating key data to their needs.

The team also assembled unique data comparing the perceptions of men and women about PIM. Farmer preferences for change was also used to shed light on new topics for the officials involved in PIM. Overall, the key message was that farmers could not be simply handed responsibility for irrigation, regardless of the fiscal constraints, without attention to institutional details, like establishment of sound compliance regimes. Moreover, there is no single fix for irrigation or PIM, but there is also no returning to top-down state-run arrangements.

Figure 7.1.7. Gender survey, Assam (left) and Bihar (right)

This message was taken up by some of the officials involved in the project, going on to explore different approaches in their own jurisdictions. In Assam, for instance, those involved with the project sought to investigate the feasibility of an entitlement regime where farmers might have more direct control. In contrast, in Punjab, the Ministry opted to take ore control after disbanding PIDA and seeking to bring more compliance via provincial influence.

7.2 Key results

The results fall into four groups of key findings covering:

- Expansion of Concepts drawn from New Institutional Economics
- Empirical Analysis of PIM using New Institutional Economics Frameworks
- Empirical Analysis of PIM using Behavioural Economics
- Gender Inclusiveness in PIM.

In this section the high-level research results are discussed under these four result categories with the location of the data source highlighted.

Expansion of Concepts drawn from New Institutional Economics

India

This body of research used concepts from new institutional economics and management governance theory to build a conceptual framework for explaining the performance of participatory water institutions. The framework identified eight institutional rationalities: technical, environmental, economic, social, political organizational, financial and government; as well as five institutional features: clear objectives, good interaction, adaptiveness, right scale, and compliance, as linked to performance. Based on this, a survey instrument was developed and deployed across more than 500 households covering 51 different water user associations in the eastern Indo-Gangetic plains states of Assam and Bihar. The data were analysed through statistical and econometric techniques including Ordered-Probit. The results showed the relevance and usefulness of the new institutional economics theory and management governance concepts in explaining the variation in institutional performance. The research also demonstrated the efficacy of the conceptual framework for studying performance. The results showed that the successful roll-out of PIM in these states hinged on the capacity to address social, economic and environmental rationalities. This challenged the conventional view that technical rationality alone is sufficient to facilitate PIM.

Detailed information about this study can be found in the open access paper, titled *Enhancing Performance of Participatory Water Institutions in the Eastern Indo-Gangetic Plains: What can we Learn from New Institutional Economics and Governance Theories*. See Table 7.2.1.1 for more information.

India and Pakistan

This part of the study considered the process of transition from an equitable distribution of water to support semi-subsistence outcomes to market-oriented agriculture. The stresses placed on water institutions, as farmers adjust production to become more market-oriented, strains the relationship between farmers and irrigation officials. Using a property rights lens, this analysis queries the sustainability of the benefactor/beneficiary relationships that have emerged in South Asia between state-run irrigation authorities and farmers, respectively. Given the difficulties of opting for a market relationship between water supply official and irrigation farmers, PIM is a logical outcome to pursue. The PIM approach can potentially accommodate greater flexibility and market orientation in agriculture but ultimately the beneficiary-benefactor relationship between irrigation officials and farmers in parts of South Asia needs to be reviewed.

Detailed information about this study can be found in an open access paper, titled *From sharing the burden of scarcity to something different: Ill-fitting water property rights and the pressure of economic transition in South Asia*. See Table 7.2.1.1 for more information.

Empirical Analysis of PIM using New Institutional Economics Frameworks

India

Although the physical development of irrigation has made considerable progress in India, the proper management and distribution of water has posed many difficulties. Through case studies and empirical analysis the variation in the performance of PIM institutions was examined. The findings revealed that in the case of India at least, inclusion of various groups of people in water institutions is common, although women and youth are not always embraced by PIM. Overall, greater inclusiveness was positively and significantly related to better performance of PIM.

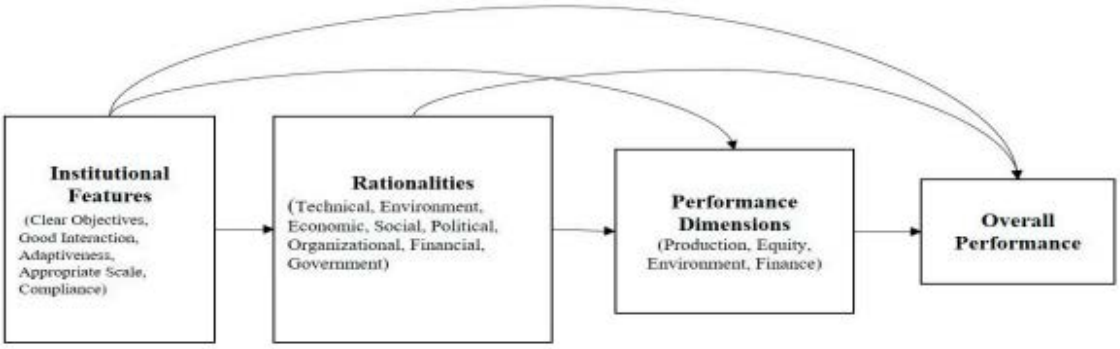
In addition, this research generated an index of devolution, endeavouring to capture the extent to which local authority was aligned with performance. The empirical analysis showed that greater levels of devolution was significantly and positively related to the performance of water user groups.

Detailed information about this study can be found in an open access paper, titled *Institutional structure, participation, and devolution in water institutions of Eastern India*. See Table 7.2.1.1 for more information.

India

The fundamentals of new institutional economics, and management governance theory have suggested the importance of a number of key factors including five institutional features and eight rationalities. This study sought to sue survey data to understand and map the relationship and pathways across these key factors. The hypothesised paths are illustrated in Figure 7.2.1 and these are explored using structural equation modelling. In the model, the five institutional features were considered determinants of the eight rationalities, and the rationalities were considered determinants of four performance goals. The results show that overall success of the water institutions (as perceived by the users/members) is closely related to the performance on the goals of production/incomes, equity, and the environment. Success is also directly linked to the achievements of technical rationality, adaptiveness, and having institutions set at the right scale.

Figure 7.2.1. Conceptual framework, relationships between factors affecting the overall performance



The results also showed that one of the most important factors determining overall performance/success was the technical rationality, and this deserved attention. It included technical expertise, sound location and quality of structures and equipment, and good maintenance. However, given the other findings, this is not sufficient to guarantee success.

Detailed information about this study can be found in an open access paper, titled *Performance Behavior of Water Institutions in Eastern India: A Study through Structural Equation Modelling*. See Table 7.2.1.1 for more information.

Pakistan

The aim of this study was to critically review the irrigation reforms package in Pakistan through an analysis of the performance of Farmer Organisations, set up as the Pakistan version of PIM. This study used a cross-sectional dataset of 567 farmers in five selected Area Water Boards (AWBs) of Punjab and Sindh provinces of Pakistan. Important institutional features including compliance, adaptiveness, clarity of objectives, good interaction, and appropriate scale, were modelled through structural equation modelling. The model was developed to understand the drivers of better overall performance. Results suggested that clear objectives, adaptiveness, scale, and compliance show a strong relationship with overall assessment of performance. In contrast to other studies (e.g. those in India), the level of interaction generated by the farmer group had no significant impact an overall performance assessment. Compliance was the largest influence over general performance. The impact of institutional feature on the overall performance assessment depends on the nature of the performance considered, e.g., drivers of the economic performance of a farmer organization may not be the same as the drivers of its environmental performance.

In addition to offering insights on specific drivers that matter for a particular dimension of performance, the study suggests that PIM institutions are still relatively immature and some appear to exist in name only.

Detailed information about this study can be found in an open access paper, titled *Impact of Institutional Features on the Overall Performance Assessment of Participatory Irrigation Management: Farmers' Response from Pakistan*. See Table 7.2.1.1 for more information.

Empirical Analysis of PIM using Behavioural Economics

India and Pakistan

Irrigation fees collected by farmers are not handled in the same manner, even within a single country. In some instances, a large portion of collected monies is retained locally and in others, only a small portion is kept for local use. In this study game theory was used to contemplate how the portion of irrigation fees retained locally might impact on the effectiveness of participatory irrigation. It turned out that there were multiple plausible

equilibria, and that allowing farmers to retain more funds locally might shift behaviour from an uncooperative equilibrium to a cooperative outcome. It is also unlikely that there is a singular fix. Empirical evidence was used to demonstrate the conundrums of making participatory irrigation sustainable.

The results showed that the local retention of monies does have an important influence on compliance behaviours. However, a confounding relationship between the local monitoring and enforcement effort and compliance was also evident. This suggests that adjusting the portion of monies held locally is unlikely to singularly transform PIM to a cooperative and sustainable state. Rather, additional support from the state/provincial governments is likely to be required to bring the levels of compliance needed for some semblance of sustainability. This finding is likely to be particularly relevant in regions where economic and social development remain a challenge.

Detailed information about this study can be found in an open access paper, titled *Farmer cooperation in participatory irrigation in South Asia: Insights from game theory*. See Table 7.2.1.1 for more information.

India and Pakistan

This study investigated the preferences of irrigation farmers for different payment apparatus for irrigation fees. It specifically queried farmers' preferred model for water governance at a local level. What was striking about the results was the diversity of outcomes across the four jurisdictions (Assam, Bihar, Punjab and Sindh) and even within countries. Within India, those who comply with paying fees prefer to see a greater proportion of revenue retained locally, but this result does not extend uniformly to Pakistan. The effect of payment compliance on preferences for the status quo was significant in both of the India samples, but is of opposite signs. The effect is significant in Punjab but not Sindh.

Detailed information about this study can be found in an open access paper, titled *Analysing irrigation farmers' preferences for local governance using a discrete choice experiment in India and Pakistan*. See Table 7.2.1.1 for more information.

Gender Inclusiveness in PIM

India

Data were obtained from the states of Assam and Bihar through a focused survey administered to 109 women in 30 water institutions. This was supported by the larger farmer-institutional survey covering 510 households and 51 water institutions. The research examined the extent and nature of the involvement of women in water institutions, as well as in farm decision-making, and the factors that prevent or foster participation. Additionally, it examined the gender congruence in views regarding water institution activities and their performance, and the perceived benefits of formal involvement of women.

The results show that inclusion is very low (except required inclusion in Bihar), and the concerns of women are usually not being taken into account. Women are involved in farming and water management decisions jointly, but seldom make decisions independently. Findings indicated that the views of women and men differ markedly on many aspects, and so their inclusion is important. Responses indicated that if women participated formally in water user associations, it would enhance their social and economic standing, achieve greater gender balance, expand their awareness of water management, and contribute to better decision-making in the water institutions.

Detailed information about this study can be found in an open access paper, titled *Gender Perspective in Water Management: The Involvement of Women in Participatory Water Institutions of Eastern India*. See Table 7.2.1.1 for more information.

Pakistan

Based on the information obtained from 128 households surveyed through separate male and female questionnaires in Pakistan in 2018 (Sindh and Punjab provinces), the country's experience in engaging gender through PIM program was considered. There was a significant difference in PIM perceptions across both gender and locational jurisdiction. Overall, women generally perceive the performance and impact of farmer organizations to be significantly less effective than men. The results of this study emphasize the importance of putting findings in a historical context to inform the theory, policy and practice of mainstreaming gender into irrigation management.

Detailed information about this study can be found in an open access paper, titled *Mainstreaming Gender into Irrigation: Experiences from Pakistan*. See Table 7.2.1.1 for more information.

7.2.1 Detailed methodology, results & conclusions

The detailed methodologies, results and conclusions are published in open access papers in the journal Water. They are in a special edition of the journal titled, *Using Applied Economics to Study Participatory Irrigation Institutions and their Impact in South Asia*. It has nine papers and an editorial. A list of the papers and links to them are in Table 7.2.1.1.

Table 7.2.1.1. Water journal papers

#	Paper Title	Author/s	Link to publication
1	Editorial—Using Applied Economics to Study Participatory Irrigation Institutions and Their Impact in South Asia	Crase, L.	https://www.mdpi.com/2073-4441/12/7/2056
2	Analysing irrigation farmers' preferences for local governance using a discrete choice experiment in India and Pakistan	Burton M., Crase, L. and Cooper B.	https://www.mdpi.com/2073-4441/12/6/1821
3	Farmer cooperation in participatory irrigation in South Asia: Insights from game theory	Hone, S., Crase, L., Burton, M., Cooper, B., Gandhi, V. P., Ashfaq, M., Lashari, B. and Ahmad, B.	https://www.mdpi.com/2073-4441/12/5/1329
4	Impact of Institutional Features on the Overall Performance Assessment of Participatory Irrigation Management: Farmers' Response from Pakistan	Ahmad, B., Pham, H. D., Ashfaq, M., Bano, R., Hussain, Z., Mustafa, R. N., Ahmad Baig, I. and ur Rehman Naseer, A.	https://www.mdpi.com/2073-4441/12/2/497
5	Performance Behavior of Water Institutions in Eastern India: A Study through Structural Equation Modelling	Jain, D., Gandhi, V. and Johnson, N.	https://www.mdpi.com/2073-4441/12/2/485
6	Institutional structure, participation, and devolution in water institutions of Eastern India	Gandhi, V., Johnson, N., Jain, D. and Neog, K.	https://www.mdpi.com/2073-4441/12/2/476
7	Gender Perspective in Water Management: The Involvement of Women in Participatory Water Institutions of Eastern India	Khandker, V., Gandhi, V. and Johnson, N.	https://www.mdpi.com/2073-4441/12/1/196
8	Enhancing Performance of Participatory Water Institutions in the Eastern Indo-Gangetic Plains: What can we Learn from New Institutional Economics and Governance Theories?	Gandhi, V. and Johnson, N.	https://www.mdpi.com/2073-4441/12/1/70

#	Paper Title	Author/s	Link to publication
9	Mainstreaming Gender into Irrigation: Experiences from Pakistan	Memon, J., Cooper, B. and Wheeler, S.	https://www.mdpi.com/2073-4441/11/11/2408
10	From sharing the burden of scarcity to something different: Ill-fitting water property rights and the pressure of economic transition in South Asia	Crase, L., Cooper, B. and Burton, M.	https://www.mdpi.com/2073-4441/11/6/1294

8 Impacts

The overall aim of this project was to influence decision makers responsible for PIM and encourage them to use an evidenced-based approach to better target the roll-out and support of PIM. The research thus has scientific, capacity and community impacts.

8.1 Scientific impacts – now and in 5 years

The scientific impacts relate to generating evidence to question the perceived pre-eminence of PIM/IMT and the one-size-fits-all devolution strategy in irrigation. The case data collected showed a wide range of outcomes within and across each jurisdiction. These findings are consistent with some earlier work that explored the outcomes from PIM but there are significant new innovations that attend the current research. More specifically, this is one of the few times that data was collected simultaneously across multiple jurisdictions seeking to apply PIM in South Asia, and the use of a similar survey instrument and data collection method allowed for pooled and un-pooled modelling of performance.

In addition to answering existing questions about PIM, the research provides a foundation for additional future analysis. Moreover, the proven usefulness of the theoretical frameworks deployed in this project could support longitudinal studies about the ongoing evolution of PIM. As noted earlier, one of the challenges with analysing PIM and unpacking success form failure has been the absence of clear data to scrutinise change. The survey instruments developed for this project could potentially fill this gap by being deployed on a regular basis to track adjustments.

For convenience and to encourage impact, the collective works were published in a single volume, following peer review. The final manuscript for this volume was published in July 2020. The track record for these papers bodes well for the scientific impact in the next five years. One month after the papers were collectively available, the data show that there have been more that 4500 complete downloads of the manuscripts and 25 citations of components of the research.

This impact likely stems for the novelty of the data as well as the decision to expand the breadth of analysis. For example, the papers dealing with gender inclusiveness have been downloaded more than 2000 times and cited on six occasions to date.

The novelty of the game theoretic analysis and the decision to expand the data gathering to include analysis of farmers' preferences with discrete choice techniques also represent significant steps in scientific analysis.

Game theory is largely underutilised in analysing irrigation management, despite its obvious usefulness for considering complex trade-offs and pay-backs. Similarly, discrete choice is widely used in developed world contexts to uncover preferences, but studies are relatively scarce in the developing world, especially when considering the management preferences for irrigation groups.

8.2 Capacity impacts – now and in 5 years

Irrigations staff involved with the end-user agencies (GoA, GoB, PIDA and SIDA) were intimately involved in the survey design and data collection processes. PIDA worked closely with UoAF to identify sites suitable for analysis and helped design the sampling frame which was used to collect data. Similarly, Mehran University of Engineering and Technology (MUET) and SIDA jointly produced a sampling frame for Sindh where data collection was completed. IIM worked with staff from GoA and GoB to design a sampling frame for data collection in those states. The sampling frame was developed to ensure that variations in performance of WUA/FO were captured in addition to capturing some

degree of variation in agroeconomic outcomes. The emphasis in most cases was on sampling from head, middle and tail reaches within the different jurisdictions.

The co-creating process provided government officials with exposure to the protocols for generating evidence on which to assess reforms. Staff from the state/provincial agencies accompanied the research teams to the field to observe and learn about the data collection process.

In addition to developing the skills of government agency staff to interrogate data, several senior level officials were challenges to think of PIM differently. This was encouraged on three different fronts. First, in the initial phases of inquiry officials were challenged to rationalise the notion of 'beneficiary' as part of the legislative and administrative discourse used to describe farmers in irrigation projects. More specifically, as part of the interview phase, key officials were asked to reflect on the consequences of persistently shaping farmers as 'beneficiaries' and how this positioned their rights to address local issues. Second, the project supported a field exposure visit in Thailand to examine how a 'partnership model' had emerged in some locations. The groups of officials from South Asia explored first-hand how decision were made jointly between farmers and irrigation department officials. The relative success of this model and the complete absence of the term 'beneficiary' in the Thai discourse was emphasised. Third, a final exposure visit was arranged for the same group of officials to Australia in order to witness a 'customer-supplier' arrangement that has emerged in irrigation. Whilst not advocating this approach specifically for South Asia, the project was able to support the capacity development of irrigation officials from the four jurisdictions and encourage them to think of how PIM might progress over the coming years.

As already noted, amongst the most obvious manifestations of this capacity development was the initiative promoted by officials from the government of Assam to develop a trial for a different water entitlement arrangement in some of its water-stressed regions.

Capacity was also developed within the research team and amongst those interacting with the team. Graduate students and postgraduates in partner countries were key to the data collection, having been specifically trained for the task. Exposure to analytical techniques formed part of their development (e.g. developing skills in DCE and SEM). This cohort developed presentation skills, having set aside the opportunity for them to present at international forums and symposia. The senior researchers in some cases have also developed new analytical techniques driven by the peer review process.

In-country members from Pakistan enjoyed the benefits of training activities sponsored by Department of Foreign Affairs and Department (DFAT) and ACIAR beyond the project.

A postdoctoral researcher was recruited on a short-term basis to assist with data cleansing and modelling. Dr Hung undertook additional training in the use of software for modelling SEM and DCE data. He subsequently transferred the learning to early career professionals at the project workshop in Bangkok and the symposium in Melbourne at the AARES conference.

Professor Lin Crase participated in security awareness training for travel to Pakistan.

Figure 8.2.1. GoA and IIM staff, piloting survey, India, July 2018

In some cases there was a direct capacity benefits through discussions with farmers – the staff involved in Bihar were directly responsible for the training of Water User Association officials and this was increased as part of the project.

Figure 8.2.2. Synthesis Workshop, participants, Colombo, September 2017

The research also led to the development of capacity for women within the state agencies. For example, in Assam female engineers accompanied members of the research team in the administration of the gender survey to better understand the comparative analysis and the process for generating empowerment scores.

The project was used to build research capability with the Indian field team providing opportunities for a postdoctoral researcher (Dr Dinesh Jain) and postgraduate researchers (e.g. Nicky Johnson). In Pakistan the MUET team included postgraduate researchers (Ms Rakshinda Bano and Mr Muhammad Ali) and the UoAF team included a PhD scholar focussing specifically on PIM in Punjab (Mr Naseer).

In addition to presenting some initial findings from his work at AARES in 2017, with the assistance of the University of South Australia, Naseer secured support from the Pakistan government for a visiting international student placement and worked directly with the UniSA team members in Adelaide in the second half of 2017.

8.3 Community impacts – now and in 5 years

8.3.1 Economic impacts

Overall

Economic impacts are difficult to attribute at this point. However, it is worth noting that during the project PIDA was dissolved by PID. This occurred on the basis of a perceived failing in the extant approach to promoting PIM. Discussions between project team members and the Punjab Minster for Irrigation were held in July 2019 around a reconfigured form of PIM, informed by the results of the project. The data from the project were used to advocate for a form of PIM that retained farmers in an advisory capacity with some leverage over funds but with monitoring and enforcement to rest with the province.

In Sindh SIDA continues to pursue irrigation devolution and the project may assist the next phase of reform.

In Bihar, the outcomes of the project were shared with the Minister for Irrigation who continues to monitor the progress of PIM with interest. The Minister has the capacity to continue to promote reforms in irrigation along the lines suggested by the evidence, to generate greater cost recovery and enhanced service delivery.

In Assam, Mr Rukesh Kumar, Secretary of Irrigation, commenced a discussion in early 2019 with the Minister for Irrigation, the Honourable Bhabesh Kalita, based on evidence and capacity generated by this project. That discussion centred on trialling a different arrangement between farmers and the irrigation department in water-stressed locations. At a workshop in Assam in September 2019, it was indicated that the discussion between the Secretary and the Minister had culminated in a decision to pilot a water entitlements system in specific locations and the Secretary subsequently sought assistance from Australian experts. The potential for Australian expertise to support this important economic impact was formally communicated to the Australian Water Partnership.

8.3.2 Social impacts

The most significant social impact resulting from project activities is related to gender. This is also an area that has attracted interest on a scientific front.

Analysis of the survey data showed that women, while generally excluded from water management, have much to offer. In addition, the views of women often differed from their male counterparts so important opportunities were potentially being overlooked now and, in the future, should their opinions not be adequately captured.

Female researchers also featured prominently in this work and there is at least some anecdotal evidence that this is strengthening the confidence of women within irrigation agencies. There is evidence that this project stimulated significant interest on the part of junior women in government, in both countries, to pursue higher qualifications and secure more prominent roles.

The decision to proceed with an extra survey, specifically aimed at measuring gender constraints and differing perceptions of water group performance, created additional opportunities and impact. Women respondents involved in the survey were largely hesitant initially but grew increasingly confident as the survey proceeded.

The initial insights from the data gathering showed that exposure to the survey instrument had itself manifested an impact. The researchers working in the field reported that some women took the opportunity of the survey to raise questions about their existing role in local water groups.

Figure 8.3.2.1. Women respond to the gender survey, Sindh, July 2018

Environmental impacts

As with the economic impacts, the environmental repercussions are difficult to determine at this point, although the longer term prospects of positive responses are encouraging.

The data analysed in India, in particular, showed strong overlap between positive performance of PIM (measured mostly as perceived improvements in water services) and better environmental outcomes. Thus, if the project has highlighted what is needed to improve overall performance of PIM and given that government agencies capacity has been enhanced, there is at least some prospect this will generate improved environmental outcomes over the next five years.

There is also a potentially strong relationship between the effective management of surface water and the propensity of farmers to excessively tap groundwater. Whilst this is not a universal problem, reducing groundwater demand by better matching surface water delivery with the needs of irrigators stands to significantly improve environmental outcomes, especially in the Indus jurisdictions.

8.4 Communication and dissemination activities

The communication and dissemination activities were via publications, meetings, workshops, fieldtrips and a symposium embedded in a national conference. Importantly, many of these communication activities were shared across the Indian and Pakistan partners.

The positive interaction between state agencies in India and provincial counterparts in Pakistan was a key feature of this project. Researchers and state/provincial partners interacted openly and in good faith throughout. Information about successes and challenges with PIM were openly discussed with the aim of enhancing regional outcomes. The travel constraints, whilst challenging on some fronts, were overcome on most occasions, leading to enhanced discourse and increased trust.

Publications

In addition to publications the related findings in a range of outlets, a special issue of the scholarly journal *Water* was produced. The special edition titled '*Using Applied Economics to Scrutinise the Impacts of Participatory Irrigation in South Asia - Namely Pakistan and India*' comprised 9 papers and an editorial that detail much of the project work. At the request of the publisher, these papers are also set to be made available as a book manuscript.

The purpose of developing the scholarly works goes beyond dissemination – it aimed to ensure that the research was rigorous and withstood peer review and provided an opportunity for capacity development amongst junior researchers. Once reviewed, the papers were distilled into digestible policy messages, including policy webinars.

Meetings, workshops, fieldtrips and conferences

The communication and dissemination activities cover national, state and district level stakeholders and range from formal events to less-formal gatherings where information was exchanged.

The survey instruments used in this project also provided a direct basis for engaging and communicating with rural communities about water management. The fact that numerous farmers responded to the discrete choice experiment by commenting they had never before been encouraged to think beyond the status quo is a case in point.

Table 8.4.1. Summary, project communication and dissemination activities, 2016-2020

No.	Date		Project activity	Location
1	2016	April	Planning and pre-inception workshop	Islamabad, Pakistan
2		May	Planning and pre-inception meeting/workshop	New Delhi, India
3		October	Meetings and workshops	Assam, India
4		October	Meetings and workshops	Bihar, India
5		November	Advisory reference group meeting	New Delhi, India
6		November	An orientation & training workshop	Assam, India
7	2017	January	Project launch	Islamabad, Pakistan
8		February	Monitoring and evaluation workshop	Islamabad, Pakistan
9		February	Meetings and discussions with Farmer Organisations	Faisalabad, Pakistan
10		February	Field visits and meetings	Punjab, Pakistan
11		May	Meetings were held at the district level	Sindh, Pakistan
12		September	Synthesis meeting	Colombo, Sri Lanka
13	2018	July	Mid-project review	Islamabad, Pakistan
14		November	Workshop	Bangkok, Thailand
15	2019	February	Australasian Agricultural and Resource Economics Society conference	Melbourne, Australia
16		February	South Asian exposure visit fieldtrip – Murray Darling Basin	Australia
17		July	Dissemination workshop	Islamabad and Lahore, Pakistan
18		September	Dissemination workshop	Assam and Bihar, India
19	2020	July	Water Journal, Special Edition	Publication
20		August	Pakistan Dissemination Activity – Webinar	Online

More detail about each project activity outlined in Table 8.51 is provided in 1 to 20 below.

1. Planning and pre-inception workshop, Islamabad, Pakistan, April 2016

The workshop was hosted by PARC in Islamabad. Workshop attendees included: Dr Muhammad Azeem Khan, Director General, National Agricultural Research Centre; Dr Nadeem Amjad, Chairman, PARC; Dr Ejaz Qureshi, ACIAR; Professor Lin Crase, Dean of Programs, Accounting & Finance, University of South Australia; Syed Shaiq Hussain Abdi, Deputy General Manager (Social Mobilization / Training), PIDA; Mr Nazir Ahmed Memon, General Manager (Transition), SIDA; Dr. BK Lashari and Dr Fateh Muhammad Marri, MUET; Dr Muhammad Ashfaq, UoAF; Dr Samina Khalil UoK; Dr Bashir Ahmad and Dr Anwar Hussain, PARC.

2. Planning and pre-inception workshop, New Delhi, India, May 2016

A planning and pre-inception workshop was held on 10 May 2016 at the Australian High Commission in New Delhi, India.

3. Meetings and workshops, Assam, India, October 2016

Table 8.4.2. Meetings and workshops with WUA members, Assam, October 2016

No.	Name of WUA	Location	District	Division
1	Malayabari Pump Committee No. 1 Pumpkendra pani Upabhokta Sanstha	Dimoria	Kamrup	Malayabari Lift irrigation Scheme
2	Malayabari Pump Committee No. 2 Pumpkendra pani Upabhokta Sanstha	Dimoria	Kamrup	

No.	Name of WUA	Location	District	Division
3	Ambari Matikhola (Uttar Nowabil) pani Upabhokta Samity	Ambari	Hojai	Jamuna Irrigation Project, Jamuna Command Area Development Division
4	JayNagar Pani Upabhokta Samity	Jaynagar	Hojai	
5	Jamuna Pani Upabhokta Samity	Dhanurhar Basti	Hojai	
6	Pam Gaon BhagayaLakhi Pani Upabhokta Samity	Pamgaon	Hojai	

4. Meetings and workshops, Bihar, India, late-October 2016

Table 8.4.3. Meetings and workshops with WUA members, Bihar, late-October 2016

No.	Scheme/Name	Name of WUA	Location	District	Division
1	Paliganj -Middle East	Paliganj (Middle East)	Paliganj	Patna	Sone Command
2	Paliganj – RP Channel 3	Paliganj – (RP Channel 3)	Paliganj	Patna	

Extensive interaction occurred between the research team and government officials in Assam and Bihar to identify case sites between December 2016 and February 2017. A checklist was developed for case selection.

5. Advisory Reference Group meeting, New Delhi, India, November 2016

An Advisory Reference Group meeting was held on 18 November 2016 at the Australian High Commission, New Delhi, India.

6. Orientation and training workshop, Assam, India, November 2016

An orientation and training workshop was held on 22 November 2016 at the Assam Administrative Staff College (AASC), Guwahati, Assam. This workshop included attendees from Assam and Bihar.

7. Project launch, Islamabad, Pakistan, January 2017

The Australian High Commission launched the project with others dealing with water management on 30 January 2017. Summary of the event is available at: http://www.awa.asn.au/AWA_MBRR/Publications/Latest_News/Australian_water_management_expertise_aids_Pakistani_agriculture.aspx.

8. Monitoring and evaluation workshop, Islamabad, Pakistan, February 2017

A monitoring and evaluation workshop was conducted over several days following the launch in Islamabad. This included input from those involved in the initial pre-inception workshop and culminated in a workplan designed to maximise impact.

9. Meetings and discussions, Faisalabad, Pakistan, February 2017

Meetings and discussions with Farmer Organisations (FOs) in Faisalabad were undertaken in February 2017. Areas visited were in the Faisalabad Area Water Board, Nasrana distributary and attendees included farmer representatives, PARC, PIDA and members of the research team. Field visits and meetings were also held in Jahang and Sargodha districts of Punjab. In addition to exchanging views with FOs local works undertaken by the FO were inspected.

10. Meetings and discussions, Faisalabad, Pakistan, February 2017

Field visits and meetings were held in Jahang and Sargodha districts of Punjab. In addition to exchanging views with FOs local works undertaken by the FO were inspected.

11. Meetings, Sindh, Pakistan, May 2017

Meetings were held at the district level in Sindh on 25-26 May 2017. Project team members including Professor Lin Crase UniSA, Professor Bakhshal Khan Lashari, Ms Rakhshinda Bano, Mr Muhammad Ali from Institute of Water Resources Engineering & Management at MUET and Mr Nazeer Issani, Mr Masroor Ahmed, and Mr Pervaiz Bhanbhan from SIDA. They visited Bulri Minor from left bank canal AWB, Tando Muhammad Khan District and Doulat Pur Minor from Nara Canal AWB, Mirpurkhas District. Open exchange covered the past and current activities of FOs, recovery rates, conflict management, involvement of youth and gender participation.

As with the Indian component of the project dissemination and information exchange is occurring at the field level as part of the gathering of case information. The key areas selected in Sindh where information was exchanged were the FO on the Bheuluri Distributary, LBCAWB and the FO on the Daulatpur Minor, NCAWB. These are both signicant regions in scale with the former irrigating around 5,260 ha and the latter around 4,450 ha.

12. Synthesis meeting, Colombo, Sri Lanka, September 2017

The synthesis meeting in Sri Lanka in September 2017 was attended by researchers and end users. The program provided for candid exchange of views on the current successes and limitations of PIM/IMT in each jurisdiction. These findings and reflections from the case evidence formed the basis of the survey development. End-users were also given the opportunity to add specific questions relevant to their own jurisdiction.

The draft survey instruments were initially developed between UniSA, IIM, UoAF, MUET and to some extent UoK. IIM, UoAF and MUET also liaised directly with GoA/GoB, PIDA and SIDA, respectively. Negotiations were also undertaken to establish the most efficacious means of deployment of surveys. There was a paper-based version of the survey being used for the farmer/institutional component, the gender survey and compliance survey. A mobile tablet form of survey was agreed for the DCE component.

Survey instruments were subsequently translated and modified to suit the local nomenclature.

13. Mid-project review, Islamabad, Pakistan, July 2018

A mid-project review was convened in Pakistan in early July 2018. Fortunately, the review meeting was attended by Professor Gandhi from IIM – this is the only time permission to travel between countries was secured and the project team is grateful to Professor Gandhi and his family. The review comprised two-days in Islamabad and two separate days presenting material and receiving feedback from PIDA at Lahore and SIDA in Karachi. Unfortunately, travel constraints were imposed on Professor Gandhi, prohibiting his attendance at the PIDA and SIDA meetings.

Attendees at the review meeting in Islamabad included former Pakistan High Commissioner to Australia, Ms Naila Chohan, and Chair of PARC, Dr Yusuf Zafar. There was also active participation from Pakistan Meteorological Department (PMD), the Global Change Impact Study Centre (GCISC) and the On-Farm Water Management (OFWM) department.

A follow-up meeting in Lahore was attended by PIDA and PIDE. In Karachi a follow-up meeting was attended by SIDA and SID.

The discussion in Lahore focussed on the extent to which PIDA was ceded autonomy by the Punjab Irrigation Department and the implications for further roll-out of PIM/IMT. In Karachi the discussion focussed on the future of PIM/IMT but where SIDA had more legislative autonomy from the irrigation department.

Both sets of audiences are keen to explore the data generated by this project as a means of establishing: (a) if further roll-out of PIM/IMT was warranted; and (b) if so, the most appropriate mechanisms to proceed. The project leader challenged the relevant government agencies to rank the most critical questions so that those questions were addressed as a priority.

A short survey instrument was invoked to capture the priorities and results provided data for the next synthesis workshop in Thailand in November 2018.

Figure 8.4.1. Pakistan Ambassador to Australia, mid-project review, Islamabad, July 2018

Figure 8.4.2. Meeting participants, mid-project review, Islamabad, July 2018

Training occurred primarily within the teams at IIM, UoAF and MUET. All three institutions involved postgraduate students and early career researchers in the project wherever possible. This involvement specifically covered survey development, translation, deployment by enumerators, piloting, debriefing and the various iterations that occur between these tasks.

In the case of MUET, 13 enumerators were trained over two days leading up to the deployment of the survey. This included familiarisation with the overall aims of the project. The training was extended to include a small number of social mobilisers based within SIDA. This small group was required to help expedite the survey but also gave additional insights to the mobilisers.

A similar number of staff was engaged by UoAF and IIM. In the case of IIM, training was extended to female engineers to assist with the gender survey taking the total number of trainees to 15.

Each team at IIM, UoAF and MUET received specialised and rapid training in the use of tablet-based instruments for data collection. This included support from CommCare, a firm contracted to develop and update the mobile application used for the DCE work.

All surveys were translated into local languages and checked against the initial questions to ensure consistency. Graduate students were involved in these tasks. Similarly, students were involved in the piloting and debriefing sessions giving additional opportunities to hone their research skills.

14. Workshop, Bangkok, Thailand, November 2018

In order to reach the point of submission each topic was exposed at the workshop in Bangkok in November 2018.

The purpose of the workshop was four-fold:

- To provide an overview of the preliminary analysis of data.
- Identify and confirm key topics of interest to end users.
- Assign responsibilities for developing specific outputs from the data which focus on key topics.
- Agree on impactful activities directed at end users.

Nine presentations were given during the workshop. The presentations are included in the list of publications in Section 10.2.

A critical theme that emerged from the entire body of work was the ongoing problems that emerge from characterising irrigation farmers in South Asia as ‘beneficiaries’. The property rights that manifest from this characterisation formed the basis of a paper published in the special edition of *Water*. To reinforce these challenges a field trip was scheduled to coincide with the workshop in Thailand.

The field exposure provided workshop participants with the opportunity to understand alternative PIM arrangements, especially in the context of a partnership approach versus the beneficiary/benefactor relationship. The field visit was attended by irrigation officials from all four jurisdictions involved in this project.

Figure 8.4.3. Workshop presentations and discussions, Bangkok, November 2018

Figure 8.4.4. Workshop participants, Bangkok, November 2018

15. Australasian Agricultural and Resource Economics Society conference, Melbourne, February 2019

A symposium on *Water management and agricultural performance in South Asia* was held at the AARES conference in Melbourne in February 2019. Eight presentations were given at the symposium.

16. South Asian exposure visit fieldtrip, Murray-Darling Basin, February 2019

Building on the exposure visit in Thailand that focussed on a 'partnership' model of water governance, an additional exposure visit was arranged to coincide with the AARES symposium in Melbourne. The overall aim was to introduce the concept of water governance based on a customer/service provider model.

Thirty-one government officials and delegates from India and Pakistan participated in the South Asian exposure visit fieldtrip in Australia in February 2019. The four-day fieldtrip visited areas of the Murray-Darling Basin in New South Wales, Victoria and South

Australia. During the trip delegates met with local Australian government officials/water authorities to discuss the rivers and the Murray-Darling Basin plan.

Figure 8.4.5. Delegation, Australian farmers and representatives, Australia, February 2019

17. Dissemination workshops, Islamabad and Lahore, Pakistan, July 2019

In order to economise on travel, the preliminary findings were tested with two groups in Pakistan in July 2019. First, a workshop was convened in Islamabad and drew attendees from national agencies. The workshop presented:

- the background to the project
- core findings from the Pakistan data on institutional performance
- a summary of the gender findings and divergence between perceptions of performance by gender and province
- detailed analysis of the drivers of compliance through the *Theory of Planned Behaviour* analysis
- a review of the findings from parametrising the game theoretic model
- key issues emerging from the DCE data
- an overall synthesis of key policy messages.

The findings stimulated positive and enthusiastic discussion, especially in the context of the national reform agenda and its emphasis on participation.

An additional dissemination workshop occurred in Lahore in July 2019. This was preceded by a briefing with the Minister for Irrigation attended by Dr Bashir and Professor Crase (see Figure 8.4.6). The Minister expressed interest in the work and opted to attend the dissemination workshop.

Subsequent discussions exposed enthusiasm for employing the findings from the project to inform future reforms in the province.

Figure 8.4.6. Project team members and Punjab government officials, Lahore, July 2019

18. Dissemination workshops, Assam and Bihar, India, September 2019

The preliminary research findings were tested on two groups in India in September 2019. First, a workshop was convened in Bihar and drew attendees from national agencies on 17 September 2019. An additional dissemination workshop occurred in Assam on 19 September 2019.

Each workshop was run over a single day and presented the following information:

- Introduction to the Project and Conceptual Background
- Enhancing Performance of Irrigation Institutions-Study
- Structure, Participation and Devolution in Irrigation Institutions
- Discussion of Findings & Implications
- Observations from Water Management & Agriculture Project Tours in Australia & Thailand
- Gender Perspective in Water Institutions: Involvement of Women
- Performance of Irrigation Institutions: Structural Equation Modelling
- Compliance Behavior in Participatory Irrigation
- Discussion on Implications & Implementation
- Observations by Advisory Group or Reviewer
- Concluding Observations.

In Bihar the workshop was also attended by top government officials. These included: Shri Sanjay Kumar Jha, Honourable Minister, Water Resources (see Figure 7.1.5); Shri Arun Kumar Singh, Development Commissioner; and Shri Sanjeev Hans, Secretary, Water Resources Department.

Figure 8.4.7. Dissemination workshop, organising committee, Bihar, September 2019

In Assam the workshop was attended by top government officials. These included: Shri Bhabesh Kalita, H
onourable Minister, Irrigation (see Figure 7.1.4); Shri Alok Kumar, Chief Secretary; Shri Avinash Purushottam Das, Principal Secretary, Irrigation; and Shri Rakesh Kumar, Secretary, Irrigation.

Figure 8.4.8. Dissemination workshop, organising committee, Assam, September 2019

Figure 8.4.9. Professor Crase presenting award, best WUA, Assam, September 2019

19. Water Journal, Special Edition, July 2020

This Special Issue focusses on PIM and aimed to scrutinise its usefulness, particularly in South Asia. The special issue comprises nine papers employing several strands of economics, including New Institutional Economics, Game Theory, and Behavioural Economics. A synopsis of each paper is provided below (see Table 8.4.4) and a list of the papers and links to each publication is in Table 7.2.1.1.

Table 8.4.4.

Categories	Author	Title	Research Topic
Expansion of Concepts drawn from New Institutional Economics	Gandhi and Johnson (2020)	Enhancing Performance of Participatory Water Institutions in the Eastern Indo-Gangetic Plains: What Can We Learn from New Institutional Economics and Governance Theories?	Expansion of New Institutional Economics to Include Rationalities and Use of Ordered Probit Regression to Test Framework using Indian Data
	Crase, Cooper, and Burton (2019)	From Sharing the Burden of Scarcity to Markets: Ill-Fitting Water Property Rights and the Pressure of Economic Transition in South Asia	Considers How Historic Beneficiary/Benefactor Relationships Hinders Efficient Irrigation
Empirical Analysis of PIM using New Institutional Economics Frameworks	Gandhi, Johnson, Neog, and Jain (2020)	Institutional Structure, Participation, and Devolution in Water Institutions of Eastern India	Background and Case Analysis in Assam and Bihar, India, Followed by Empirical Validation of Relationships between Success and Institutional Features
	Johnson, Gandhi, and Jain (2020)	Performance Behavior of Participatory Water Institutions in Eastern India: A Study through Structural Equation Modelling	Structural Equation Modelling of PIM Performance in Assam and Bihar, India
	Ahmad, Pham, Ashfaq, Memon, Bano, Dahri, Mustafa, Baig, and Naseer (2020)	Impact of Institutional Features on the Overall Performance Assessment of Participatory Irrigation Management: Farmers' Response from Pakistan	Factor Analysis Followed by Structural Equation Modelling to Explain Drivers of PIM Performance in Punjab and Sindh, Pakistan
Empirical Analysis of PIM using Behavioural Economics	Hone, Crase, Burton, Cooper, Gandhi, Ashfaq, Lashari, and Ahmad (2020)	Farmer Cooperation in Participatory Irrigation in South Asia: Insights from Game Theory	Development of a Game Theoretic Model to Explain Noncooperation and Parameterization using Survey Data on Compliance in India and Pakistan
	Burton, Cooper, and Crase (2020)	Analysing Irrigation Farmers' Preferences for Local Governance Using a Discrete Choice Experiment in India and Pakistan	Explaining Preferences for Changes to PIM using Data Drawn from Pakistan and India
Gender Inclusiveness in PIM	Memon, Cooper, and Wheeler (2020)	Mainstreaming Gender into Irrigation: Experiences from Pakistan	Analysing Barriers to Women Participating in PIM and the Different Perceptions of PIM Held by Men and Women in Sindh and Panjab, Pakistan
	Khandker, Gandhi, and Johnson (2020)	Gender Perspective in Water Management: The Involvement of Women in Participatory Water Institutions of Eastern India	Analyses the extent of inclusiveness in PIM in Assam and Bihar, India

20. Pakistan, Dissemination Activity, Webinar, August 2020

In order to finalise the dissemination in Pakistan, a dissemination workshop was initially planned for early 2020. However, changes in the travel environment made this impossible and an online panel discussion webinar was organised as an alternative dissemination activity. This event was attended by government officials and experts from relevant departments in Pakistan, in-country project partners, an Australian expert and members of the Australian research team.

The panel of experts (invited speakers) addressed questions related to:

- Are there rudimentary techniques that maintain farmer engagement regardless of setting?
- Can the successes of one location be translated?
- Are there other ways to leverage across the different aspects of government?

The webinar was recorded and will be edited to create a video that can be used for dissemination in Pakistan.

Figure 8.4.10. Webinar, flyer, August 2020

9 Conclusions and recommendations

The methodology, results and conclusions associated with the different parts of the project are captured in the special edition of the journal Water titled, *Using Applied Economics to Study Participatory Irrigation Institutions and their Impact in South Asia*. Collectively these papers comprise the main empirical findings of the project but its impacts extend beyond this.

There is evidence that the project has directly expanded the mindset of official responsible for PIM in South Asia, as was always intended. First, there is now at least some signs of a growing penchant for considering the evidence around the impacts of PIM rather than relying on its presumed benefits in application. Second, there is also clear questioning of the status quo. Third, the project can directly claim impact on the challenge to the water entitlement structures in Assam and the interest in trialling alternatives.

The magnitude of these impacts cannot be immediately assessed but it is worth noting that water reforms in Australia took several decades to prosecute and are now credited with generating billions of dollars of additional welfare in agriculture and the economy generally. It would be reasonable to expect reforms to thinking about PIM will take at least as long to resolve in India and Pakistan.

9.1 Conclusions

For many decades, participatory approaches, with their emphasis on farmer-centred management, have been presented as panaceas for overcoming weaknesses in irrigation systems.

PIM has assumed such a high status that it is regularly mandated by donors sponsoring irrigation upgrades in poor countries. However, the success of PIM is mixed, and economic analysis can help explain why PIM might work in some settings and not in others or why different versions of PIM are needed. This project focusses on PIM and aimed to scrutinise its usefulness, particularly in South Asia. The focus on South Asian irrigation was driven by the reality that smallholder agriculture is destined to be the mainstay for this most populous region, at least in the medium term, and finding solutions to raise agricultural productivity is a high priority. At its theoretical foundations the project employed several strands of economics, including New Institutional Economics, Game Theory, and Behavioural Economics. Importantly, the project was designed to simultaneously engage decision makers and involve them in a discourse about options for the future. We argue the project has delivered on that ambition.

Irrigation management in South Asia faces a confronting crossroad. Agrarian activity is still the economic mainstay for much of the region, and irrigation has long been touted as a means of providing more stable and better livelihoods for smallholders. Providing access to reliable water for crop production continues to be one of the main policy goals for most governments, but delivering on this ambition has not always been straightforward. Amongst the most vexing issues has been the efforts by governments to simultaneously improve the functioning of irrigation while having farmers play a more active role in the management of water delivery.

Arguably, there is a continuum of decision making where famers can be more (or less) involved. The literature often makes a distinction between PIM and IMT with the latter interpreted as a shift in ownership of irrigation assets to farmers and thus a more extreme case of ‘’participation”. In practice, PIM and IMT are often indistinguishable. The idea of involving farmers more actively in irrigation decision making has seen the management of some parts or some functions of irrigation networks devolved to farmer groups, thereby marking a distinct contrast with the historic top-down management or irrigation by state-run bureaucracies. This general push towards devolving decisions to farmers arose in the 1980s and became a central tenet for most donor agencies thereafter. For instance, the

Food and Agriculture Organisation of the United Nations promoted an irrigation modernization program in the 1990s where technical upgrades had to be simultaneously accompanied by managerial upgrades, with a greater focus on improving resource utilization and more efficient delivery to farmers. The relative success of PIM has been investigated over an extensive period. Many analysts noted the early trend where PIM did not to deliver the expected improvements in irrigation performance. However, the overall quality of the scientific literature that deals with the relative benefits of PIM varies considerably. Although numerous studies are available, the methodology for reporting on changes attributable to PIM generally comprises a range of ‘’success” indicators, which are often inconsistent. Most analyses are necessarily backward looking and attempt to infer what may have encouraged or limited success. Few studies attempt ex ante assessment of the uptake of PIM and, despite observations that local context is critical, research “has failed to dislodge Water User Associations and PIM/IMT from their pre-eminent position in irrigation reform projects and programs”.

Gaining a better understanding of what drives successful PIM remains a key issue in South Asia, with few policy alternatives on offer. Governments simply do not have the resources to adequately manage the entire irrigation network, and the political costs of mismanaged irrigation are also high. Regrettably, it is the smaller and poorer farmers who stand to lose most when surface water is not well managed. This group is often at the tail end of the network, and if deprived of water this cohort usually does not have the financial resources to substitute groundwater. Women farmers are also often sidelined when PIM fails to function effectively. This project was adjusted to bring together several perspectives and empirical analyses of PIM in South Asia. Applied economics provided the analytical lens that underpins the research.

The outputs from this project fall into four main groups. The first group make a theoretical contribution to scrutinizing PIM, specifically drawing on and expanding concepts related to New Institutional Economics. The second group of outputs centre on empirical analysis, with each endeavouring to describe the drivers of successful PIM. The third group offer empirical insights but do so through relatively novel approaches to the PIM domain. This includes analyses based on game theory and discrete choice experiments. The final group of outputs takes up the issue of inclusiveness in PIM, and provides analysis of gender perspectives.

9.2 Recommendations

Collectively, the outputs from the project offer key insights into the challenges of making PIM more effective in South Asia. Clearly, government plans that promote PIM require more effort and local nuances matter a great deal. In that context, attention to detail and clear assignment of responsibilities within the capacity of individuals and groups deserve more scrutiny. Australian researchers can assist with this identification process and should be encouraged.

There is little doubt that PIM is here to stay; there are no other feasible options for countries like India and Pakistan. Taking lessons from this project to improve the current functioning of PIM stands to significantly enhance its legacy and support broader development agendas. As a minimum, the direct requests for assistance from Assam to trial alternative water management regimes should be positively considered.

Critically, this research has not occurred in a vacuum and key government stakeholders were engaged and are now emboldened and supported to contemplate change. But the challenges in South Asian cannot be underestimated and the support of countries with a strong track record of successful irrigation and water reform, like Australia, will remain important.

Continued support for international dialogue on water affairs is clearly in Australia's interest. The Australian experience with water reform and dealing with devolved decisions in irrigation is not perfect; but it does embody significant successes to buttress discourse about the global efforts to enhance water resource management.

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11 Appendix

11.1 Appendix 1: Abbreviations & Acronyms

AARES – Australasian Agricultural & Resource Economics Society

ACIAR – Australian Centre for International Agricultural Research

AID – Assam Irrigation Department

AWA – Australian Water Association

AJARE – Australian Journal of Agricultural and Resource Economics

CEEW – Council on Energy, Environment and Water

DCE – Discrete Choice Experiment

DFAT – Department of Foreign Affairs and Trade

FAO – Food and Agriculture Organization

FO – Farmer Organisation

GCISC – Global Change Impact Study Centre

GoA – Government of Assam

GoB – Government of Bihar

IIM – Indian Institute of Management (Ahmedabad)

IMT – irrigation management transfer

IWREN – Institute of Water Resources Engineering & Management (at MUET)

LBCAWB – Left Bank Canal Area Water Board

MUET – Mehran University of Engineering and Technology

NCAWB – Nara Canal Area Water Board

NYU – New York University

OFWM – On-Farm Water Management

PARC – Pakistan Agricultural Research Council

PIDA – Punjab Irrigation and Drainage Authority

PIDE – Pakistan Institute of Development Economics

PIM – Participatory Irrigation Management

PMD – Pakistan Meteorological Department

SEM – Structural Equation Modelling

SIDA – Sindh Irrigation and Drainage Authority

UoAF – University of Agriculture Faisalabad

UniSA – University of South Australia

UoK – University of Karachi

WUA – Water Users' Association