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Analysing Irrigation Farmers' Preferences for Local Governance Using a Discrete Choice Experiment in India and Pakistan

Michael Burton [1], Bethany Cooper [2] and Lin Crase [2,*]

[1] School of Agriculture and Environment, The University of Western Australia, Crawley, WA 6009, Australia; michael.burton@uwa.edu.au
[2] UniSA Business, University of South Australia, Adelaide, SA 5001, Australia; Bethany.Cooper@unisa.edu.au
* Correspondence: Lin.Crase@unisa.edu.au

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Abstract: This paper reports the results of an investigation into the preferences of irrigation farmers for different payment apparatus for irrigation fees. We also report the results of a study that queried farmers' preferred model for water governance at a local level. The results and analysis thus make an important contribution to the debate about how participatory irrigation might operate more effectively, especially in India and Pakistan. The rationale for this study is that aligning the payment mechanisms and local water governance more closely with farmer preferences is likely to reduce the barriers to accepting participatory irrigation and the requirement to pay water charges. To the knowledge of the authors, no other study has specifically addressed this issue by seeking direct feedback from farmers.

Keywords: discrete choice experiment; irrigation farmers; South Asia; participatory irrigation management; farmers' preferences

1. Introduction

Despite major intellectual contributions analysing the theoretical linkages that drive cooperative behaviour amongst irrigation farmers (e.g., [1]), the weaknesses of participatory irrigation management and its application in developing countries continue to be documented (see, for instance, Groenfeldt and Svendsen [2]). Crumbling infrastructure and poor water delivery combine to undermine efficient crop production and the flow on effects to income variability and food insecurity are real. There is also ample evidence that the current arrangements are far from equitable, with smaller, poorer farm households generally more exposed than others [3]. It is also the case that politics and irrigation are closely linked and it might not be that surprising, given that a large portion of the voting population tends to be involved in agriculture in less-well-off democracies, like India and Pakistan. Water pricing and tariff collection are especially contentious and characterized by realpolitik in South Asia [4]. Price and his colleagues [5] drew upon almost 500 interviews of water experts in the region and, in addition to finding general discontent with domestic water affairs, uncovered clear agreement between Indian and Pakistani officials that irrigators should pay more than they do currently ([5], pp. 17–18). However, overcoming the political hurdles to achieve tariff reform and decentralized water management has long been identified as two related but critical constraints in the region [6].

The failure to collect sufficient monies from irrigation farmers for the use of the irrigation network means the sequence of poor water delivery-low productivity-low incomes-inadequate cost recovery and maintenance perpetuates. In Pakistan, for example, the rate at which irrigation fees are set is sufficient to cover only one quarter of the operations and maintenance costs [7], and this excludes the

prospect that not all farmers will pay or the requirement to fund system improvement. The consequence is that irrigation systems rely heavily on subsidization from the state but given the pressures on the fiscal resources of many developing countries, government transfers cannot bridge the gap to realize genuine improvement. Donors from richer nations are subsequently drawn into this domain but this has realized repeated cycles of "build-neglect-rebuild" ([8], p. 2).

At the core of the problem is the extent to which irrigation farmers can and will contribute to the maintenance and upkeep of the irrigation system. Numerous analyses have shown that there are gains from accessing irrigation that far exceed the monies being sought from farmers to maintain the system (e.g., [9]). The fact that many farmers with access to surface water irrigation simultaneously expend large sums of money to secure groundwater points to the value of water. Put simply, there is evidence of sufficient economic rents from water to encourage voluntary payment of irrigation levies so the question is "why is it that more farmers do not pay more?".

This question has stimulated multiple studies of irrigation and irrigation farmers in a participatory irrigation context (see, [10]). Many of these analyses have focused on the quality of the irrigation "service" and concluded that farmer reluctance to pay could be overcome if water delivery was more reliable (e.g., [11]). However, these analyses tend not to delve into how the current nexus between unreliable delivery and poor cost recovery will be broken. In contrast, other studies have focused on the higher-level process of transitioning to a more sustainable model (e.g., [8]) arguing that the mechanics of transition are key to success. For example, Salman et al. [12] note that the relative success of participatory irrigation in Jordan was partly related to the willingness of stakeholders to make adjustments in the course of implementation. Overall, varying models of governance and power-sharing have been proffered as a means of securing more voluntary involvement (i.e., payment) by farmers but the degree of actual acceptance by farmers is not clear.

Game theoretic and experimental approaches have also been used to explore this topic. For example, Ostrom, Walker, and Gardner [13] and Ostrom, Gardner, and Walker [14] established a tradition of exploring the management of common pool resources, like irrigation, using these approaches. Similarly, Ibele, Sandri, and Zikos [15] explore the extent to which endogenous and exogenous rules in water management can lead to improved outcomes by using several rounds of a game applied to 70 farmers across three case sites in the Mediterranean region. Overall, these types of studies point to the potential benefits of devolved decision making in irrigation, but the outcomes in practice are varied. What has been missing from these studies, especially in South Asia, is an understanding of the specific preferences of farmers around (a) how they will be charged for water and (b) the composition of the local institutions that would administer irrigation supply and management. In part, this gap stems from the historic centralized management of irrigation where, in effect, farmers were treated as "beneficiaries" and whose preferences were pre-determined by the state-run irrigation departments [10].

Against that background, a team of researchers from Australia partnered with research teams based in India and Pakistan to better understand the preferences of Indian and Pakistani farmers around water charging and irrigation administration. The key research question was "what are the preferences of farmers for reforms to water charging and irrigation management in South Asia?" The partnership formed to address this question was partly based on research experience with irrigation farmers in Australia, where irrigation management has been extensively devolved but irrigation tariffs are frequently adjusted to align with farmer preferences (see, for example, [16]). The research was further motivated by calls for assistance from local irrigation authorities, expressing increased frustration about the slow pace and varying sustainability of participatory irrigation in their jurisdictions.

This paper reports the results of an investigation into the preferences of irrigation farmers for different payment apparatus for irrigation fees. We also report the results of a study that queried farmers' preferred model for water governance at a local level. The results and analysis thus make an important contribution to the debate about how participatory irrigation might operate more effectively, especially in a setting like India and Pakistan. India and Pakistan remain large agrarian economies with many smallholder farmers heavily dependent on irrigation. The well-being of millions of farm

households is at risk due to mismanagement of irrigation, especially in the Indus Basin in Pakistan and the north eastern states of India where poverty is endemic. Both regions have had mixed experiences with participatory irrigation and the management of communal irrigation is both economically and politically important. The rationale for this study is that aligning the payment mechanisms and local water governance more closely with farmer preferences is likely to reduce the barriers to accepting participatory irrigation and the requirement to pay water charges. However, to accomplish this task, it is first necessary to understand the preferences of farmers on these topics. One approach to uncovering farmer preferences is to use stated-preference techniques where attributes of a policy are weighed by offering respondent farmers discrete choices that are systematically repeated. To the knowledge of the authors no other study has specifically addressed this issue in South Asia by seeking direct feedback from farmers using a stated-preference discrete choice experiment.

The paper itself is divided into seven additional parts. In section two we briefly review the extant problems with participatory irrigation in the study region and summarize the various analytical approaches used to test different hypotheses. Section three provides a synoptic overview of the discrete choice experiment literature while section four describes the development of the choice experiments used in this study. A summary of the choice data is presented in section five and results for the alternative choice models are presented in section six. Analysis of results and brief concluding remarks make up sections seven and eight, respectively.

2. The Challenges of Participatory Irrigation in India and Pakistan

Irrigation itself can take on different forms ranging from small-scale localized provision of supplementary water to wide-scale distributed networks supporting highly irrigation-dependent activities. The latter is estimated to occupy around 45 per cent of the world's total irrigated land [17] and is credited with underpinning globally significant crops like rice, wheat, cotton and sugarcane [18]. Importantly, large-scale surface water irrigation networks also generally rely on gravity and thus use far less energy than other irrigation technologies [19].

Irrigation is seen by many as being critical to enhancing the livelihoods of the rural population and meeting key challenges around food production and security. The contribution of irrigation and the role around better policies and institutions to make the most of irrigation are characterized by Bhattarai, Sakthivadivel and Hussain ([20], p. 14) in Figure 1. Here, irrigation is presented as a means of lifting household incomes in a region, but not uniformly given existing policies and institutional settings. Moreover, the tail end of the income distribution under the irrigation scenario (Region B) with existing policies is presented as only mildly superior to the average income without irrigation. The skewness of income in Region B relates to the failure of existing institutions to adequately manage the irrigation network and substantial inequities ensue. In contrast, policy and institutional reform (Region C) is presented as both delivering greater income and reducing inequality.

Whilst conceptually convenient in demonstrating the role of irrigation and why governments worldwide have supported irrigation projects, the mechanics of policy and institutional reform required to move from Region B to Region C is less clear. Over the last 30 years, policy and institutional reform in irrigation have centred on gaining greater involvement of farmers in decision-making as a means of achieving this shift.

The logic of this approach is supported by numerous governance principles including Oates (1972) theorem [21]. Oates [21] argued that decentralised decision making for the provision of communal goods is generally superior to centralised decisions, inasmuch as there is improved scope for matching the calibre of supply with the community's preferences to pay. Thus, all decisions should be allocated to the lowest tiers of governance as a default measure. Oates [21] acknowledges two cases where decentralised choices will not strictly be superior: (1) if there are spill-over effects between jurisdictions (e.g., excess use of a resource in one jurisdiction impacts welfare in another), and (2) if there are economies from making decisions at a higher level (e.g., it is cheaper to build one coordinated piece of infrastructure than two uncoordinated works).

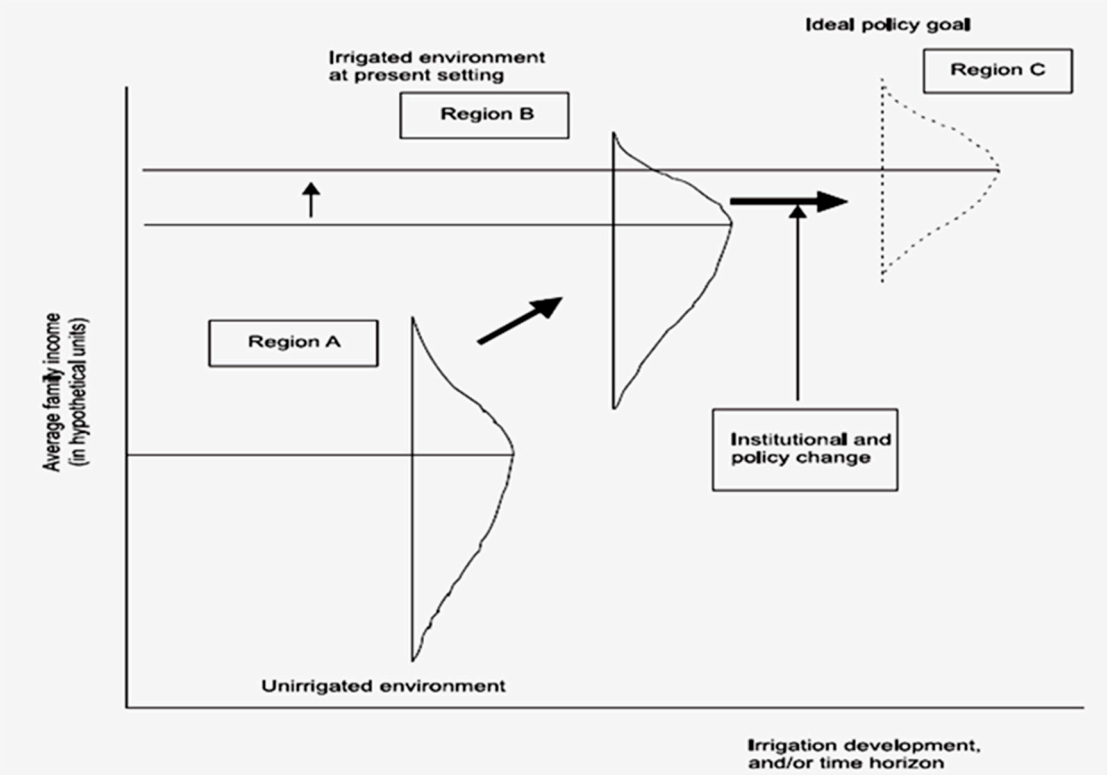

Figure 1. Conceptual framework for considering irrigation development ([20], p. 14).

Arguably as a result of these two caveats, participatory irrigation in the developing world has generally not resulted in the complete devolution of responsibility for water supply to local farmer groups; rather, models have emerged where the tasks related to irrigation are shared between a centralised agency (e.g., state or provincial irrigation department) and subordinate groups that seek to represent the collective interest of farmers (e.g., farmer organisations or water user associations). Ostrom [1] and others describe these types of arrangements as polycentric, where decisions are made at different scales with varying degrees of autonomy and integration.

It is important to note that these models of shared responsibility are not homogenous, even within a single country, and in that context considering multiple jurisdictions has the advantage of presenting a range of different governance scenarios. With this in mind, this study drew upon evidence in two states in east India—Assam and Bihar—and two provinces in Pakistan—Punjab and Sindh. The hydrological and agricultural setting for these case sites is reported in Hone et al. [22].

There are several dimensions over which governance of irrigation might be contemplated. One dimension relates to the channels over which different groups manage. As a general rule in South Asia, larger channels remain controlled by state and provincial governments and the management of smaller distributaries is vested in farmer groups, at least in part. However, what needs to be understood is that even at the distributary scale there are marked variations in the management principles and protocols.

First, the way water fees are established can vary, with some locations opting for an area-based charge whilst others might invoke a payment on the basis of crop. The latter would usually seek to take account of the higher water demands of some crops than others (e.g., sugarcane versus wheat). Second, the frequency with which payment is required could diverge—for instance by season or annually. Third, the personnel who physically assess the area of land for which payment is due need not be the same—in some cases this is done by state-employed personnel and in other cases a representative of the farmer group undertakes the assessment. Fourth, the collection of fees need not be identical. For instance, in some cases a collection agent might have this role and receive a dividend

from collections, or the state government might play this role, or an official empowered by the farmer group. Fifth, the requirement to contribute labour to undertake local maintenance might fluctuate. In some cases, this is mandatory and in others water-users can opt to provide additional cash to substitute for their labour. Sixth, the assessment of the works to be done can contrast with state engineers supervising works whilst in other cases local farmers might hire contractors. Seventh, the application of sanctions differs—state officials can be involved, or local farmers can invoke penalties or it might be combined. Eighth, the funds collected from farmers can be redistributed in different ways and might involve complete transfer to the superordinate state/provincial coffers or a portion might be held for local use. Ninth, the agreement about the condition of the infrastructure at the time of devolution to farmers need not be the same. For example, in some cases the irrigation department might opt to hand over control only once a commitment has been made to upgrade while in other cases no such commitment could exist.

It is important to note all of these governance features can have a material impact on the willingness of farmers to embrace participatory irrigation in general and to pay the monies that are due in particular. However, little primary data is available to test this hypothesis and with that in mind, a discrete choice experiment was envisaged as shedding light on the relative importance of the various elements of participatory governance from the perspective of farmers. There is also evidence on how this method can be used to subsequently design tariffs faced by irrigators that are more in line with their preferred approaches to payment [16].

3. A Synopsis of the Discrete Choice Approach

Discrete choice experiments are a survey technique that can be used to better understand how individuals make trade-offs around the attributes that make up a product or service. They can be particularly helpful when the product/service is new and/or not exchanged in a market. Commonly, choice experiments include a price variable so that the analyst can consider how respondents trade-off price against changes in other attributes. In this instance, it seemed incongruous to ask farmers to pay for a new tariff structure of water institution but given that irrigators in South Asia are seldom consulted and decisions around tariffs and water administration are imposed "top-down", the technique could shed light on how irrigators view alternative arrangements. The approach is also well-suited to address the primary research questions around preferences for payment and water administration. Discrete choice experiments are underpinned by random utility theory [23] where the frequency with which a participant selects one alternative over another is linked to the benefits (i.e., utility) assigned to the alternative. Choice modelling is one form of discrete choice and is a widely employed stated preference technique (see, for example, [24,25]). The popularity of the technique is in part due to the notion that it is able to replicate real markets where individuals make choices between products based on various attributes [26]. Notably, choice experiments can also be helpful for testing new policies or ideas that have not yet been administered. Here, the product/policy attributes are varied, and a respondent is presented with a choice set comprising alternatives (usually two or three) from which they must choose one. By varying the attributes systematically over a number of choice sets, the resulting choice data then expose how individuals are making trade-offs and a value can then be assigned by comparing trade-offs with a monetary attribute in the experiment. If an experiment is conducted without a monetary attribute some information on preferences is still generated, but it is necessary to consider the marginal rate of substitution between attributes in something other than monetary terms. Data from choice experiments enable us to enumerate the trade-offs individuals make between the attributes of a product, policy or outcome.

In the current context, choice experiments can assist in providing insight into the acceptability of different policy or administrative options faced by irrigation farmers that have hitherto not been implemented.

The workhorse model for analysing preferences from a discrete choice model is the logit model. If the utility obtained by individual n from alternative j is given by

$$U_{nj} = \beta'_n x_{nj} + \varepsilon_{nj} \quad (1)$$

Here x_{ij} is a vector of attributes, and β_i a vector of parameters that represent the marginal utilities of those attributes (which may vary across individuals) and ε_{ij} represents the unobservable components of utility. If the latter is distributed as *iid* extreme value, then the probability that an individual selects alternative i from a set of J is given by

$$P(i \mid \beta_n) = \frac{\exp(\beta'_n x_{ni})}{\sum_j \exp(\beta'_n x_{nj})} \quad (2)$$

There are diverse methods of accounting for heterogeneity in preferences implied by specifying the marginal utilities to be individual specific. These include mixed logit models that specify them to be random distributions, latent class models that specify them as discrete values that vary across latent classes, and deterministic models that specify them as functions of observable characteristics (see Train [27] for a definitive statement of model types). In the analysis that follows sample sizes are not large, and we apply a relatively simple specification allowing marginal utilities to be a function of observable characteristics only.

Whilst econometric modelling of choice data continues to improve, the application of choice experiments in emerging economies can face numerous challenges. The option of online surveys for instance is not available, making it costly to assemble data. In addition, the cognitive demands from dealing with abstract attributes and levels can also be problematic for individuals with limited literacy. However, many of these constraints can be addressed by careful survey design and administration (see, [28]). In this case, the design phase for the choice experiments comprised interviews, focus groups, survey pretesting and estimation of an efficient design [26]. This process is discussed in detail in the following section.

4. The Development of the Discrete Choice Experiments (DCEs)

4.1. Attribute Development

In the previous section it was noted that discrete choice experiments are premised on participants assessing the value of an option by cumulatively considering the bundle of attributes on offer and the related levels. It was also noted that there are numerous dimensions over which local governance might vary, ranging from different configurations of payment through to how resources are controlled and used to maintain the irrigation network. To gain a better understanding of these dimensions, qualitative methods were first employed to inform the design of the choice experiment.

This phase involved over 20 face-to-face interviews with irrigation officials, which were conducted by both Australian and South Asian members of the research team. These interviews took place across the four study locations—Bihar, Assam, Punjab and Sindh—and in some instances the opinions of high-level officials (e.g., Ministers) were also canvassed. The selection of interviewees was based on two sources of information. First, a review of the policy frameworks in each jurisdiction was used to identify which officials had primary responsibility from promoting participatory irrigation. Second, input from in-country research experts in water management helped identify those officials who had a range of experiences that they would likely be willing to share. The interviews were semi-structured comprising open-ended questions related to concepts such as: the current functioning of Water User Associations or Farmer Organisations; the management of financials (e.g., collection of funds, transfer of payments) by the farmer group; the maintenance of infrastructure and its adequacy; the frequency with which tail end farmers did not receive water; mechanisms for encouraging payment and the application of sanctions; the involvement of different groups in decision making; the extent of

"democracy" in the group versus capture by elites; the level of trust between state/provincial officials and farmers. The feedback from state/provincial officials suggested that many of these attributes were fixed by the state/province and did not vary across villages or water user groups.

In addition to acquiring the perspective of irrigation officials, focus discussions with farmers across the four study locations were conducted by the research team (i.e., Australian researchers in the company of Indian or Pakistani researchers) and facilitated by interpreters familiar with the local dialect. Again, these discussions were semi-structured and followed a similar line of inquiry to the interviews with officials. In many cases the research team was also accompanied by irrigation officials, in part due to concerns about the safety of travel in some regions. The selection of the farmer groups was based on advice from irrigation officials who were asked to nominate Farmer Organisations or Water User Associations that were functioning well (poorly); operating at the head (middle/tail) of the irrigation network; and had a long (short) history with participatory irrigation.

Subsequent to this initial phase of the experiment, an extensive number of potential attributes were identified. Given the diverse and large number of potential attributes, a decision was made to divide the choice tasks into two separate experiments—one dealing solely with payment by farmers (DCE 1) and the other covering the functioning of local water governance (DCE 2).

4.1.1. DCE 1: Payment

The "payment" choice experiment for pre-testing was established with four attributes covering: how the payment was calculated (on area, crop or a combination); frequency of payment (annually or by season); who made the assessment of what was owed (local farmer versus state officials or both); and to whom collection was paid (a local agent or a state official).

4.1.2. DCE 2: Governance

The initial broader "governance" choice experiment for pre-testing comprised five attributes: the share of revenues that would be retained locally (the residual of what was reportedly passed to the state/province); the arrangements for hand-over of responsibility (reflecting both time and quality of infrastructure at hand-over where immediate hand-over implied a lower quality and longer timeframes would be accompanied by more upgrades); the responsibility for imposing sanctions (whether locally-appointed and devised sanctions would apply or if this came from the state); the mechanisms for local maintenance (whether this relied solely on monetary payments, a contribution of labour or both); and how expertise would be brought to bear around the engineering works (whether this would reside with the state/province or the local farmers hired in and directed works).

4.2. Survey Pre-Testing

An orthogonal design was initially employed for both choice experiments (DCEs 1 and 2) and this was nuanced to ensure that the levels assumed to hold in the status quo did not appear as one of the choice alternatives. This was done by ensuring that at least one of the attributes in each design did not mirror what the state or provincial rules were for payment of fees and the mandated local governance. To reiterate, this was initially based on the data from the qualitative interviews that suggested the state/provincial rules were adhered to across each jurisdiction. A pre-test of the experiments was conducted with 30 participants during May 2018 in Assam and Bihar only. This was done as the field teams in India were more advanced on data collection for the broader project than those in Pakistan. In addition, the demands of field collection due to the approaching monsoon season in east India required that this activity proceeded ahead of the later monsoon in Pakistan. The data were collected by an Indian team of researchers managed through the Indian Institute of management, Ahmedabad (IIM-A). The team was selected because of their wide experience in field data collection and the high regard in which the IIM-A was held in the region. The team used mobile tablets purchased for the task and those administering the survey translated questions into the local language. Responses were then recorded and uploaded online each day.

The pre-testing revealed two important insights. First, the local rules around payment and governance did not always match the state-based rules that were supposedly mandated. There were numerous cases where both payment and governance had morphed to something that did not match the status quo that had been assumed. Farmers questioned in the privacy of their home admitted to adopting local rules and structures that did not match those of the state. This may well have emerged because of the pressure felt by farmers in the earlier qualitative phases, where interviews occurred with state/provincial official and international researchers present. Second, famers expressed concern about comprehending the governance experiment (DCE 2) and struggled with the complexity of some attributes.

On the basis of these findings two adjustments were made to the final survey. First, in the final survey the status quo was not auto-populated with the state rules; rather the administrator was required to ask the respondent directly the actual payment and governance arrangements at the commencement of the survey and this then became the status quo that fed into the experiments automatically. In addition, the governance choice experiment (DCE 2) was simplified and some attributes were excised—specifically, the attributes relating to transfer of infrastructure and whether local groups hired in experts or used government engineers were removed.

The final attributes, levels and coding used for the payment experiment (DCE 1) and the governance experiment (DCE 2) are presented in Tables 1 and 2, respectively.

Table 1. Discrete Choice Experiment (DCE) 1: Attributes, levels and coding for payment experiment.

Attribute	Levels	Coding
Basis of charging	Fixed amount based on area irrigated; Amount based solely on crops grown; Fixed fee plus an amount based on crop	Area (A = 1); Crop (C = 2); Both (B = 3)
Assessment method	By government official; By local person appointed by the water users/farmers; Jointly by both	Gov Official (O = 1); Water user (W = 2); Jointly (J = 3)
Payment method	Paid every cropping season; Paid once per year	Season (S = 1); Annually (A = 2)
Collection method	Paid to government official; Paid to local water users/farmers and their officials; Collected by both water users and government	Government official (O = 1); Water users (W = 2); Jointly (J = 3)

Table 2. DCE 2: Attributes, levels and coding for governance experiment.

Attribute	Levels	Coding
Share of irrigation fees kept locally (versus transferred to state)	0; 20; 40; 50; 60; 70; 80	20; 60; 80 are only alternative seen
Sanctions for non-compliance with rules	Enforced by state government; Enforced by local farmers and water users; Enforced by both government and local farmers	State (O = 1); Local (L = 2); Jointly (J = 3)
Method of maintaining local irrigation system (e.g., water courses)	Taken from irrigation fees only; 100% through in-kind labour; 50% through fees and 50% in-kind labour; Through a combination of local resources and state/provincial resources	Taken from local fees, i.e., cash (C = 1); Through local labour only (L = 2); Through cash and labour (C/L = 3); Local as well as state/provincial resources (J = 4)

5. Main Survey and DCE Designs

5.1. Main Survey

The main survey comprised three sections. The first section asked questions about how payment was currently made and the governance arrangements that related to each attribute in Tables 1 and 2, respectively. As each of these responses was recorded, they formed the status quo for the related

experiment. Respondents were also asked how much they currently paid in irrigation charges. This was done to ensure that the choice experiment held the actual fee constant—in effect our interest lay in the relative influence of the structure of charges and governance not in the direct cost itself. In this section, respondents were also asked their perceptions of their own compliance with payment and the compliance of neighbours. This was done using a 5-point Likert scale ranging from paying "hardly ever" to "about a quarter of the time", "about half the time", "about three quarters of the time", to "nearly always".

The second section included a choice experiment on farmers' preferences for irrigation payment methods (DEC 1). In keeping with the literature on cheap talk (see, for example, [29]), statements were also included that emphasised the salience and importance of respondent feedback. In addition, where the status quo was repeatedly chosen, the survey design automatically diverted to a series of questions that sought to explore protestor responses.

The third section of the survey embodied a choice experiment related to governance of the irrigation group (DCE 2). Similarly, questions were included to investigate protestor responses if the respondents always chose the status quo option.

Notably, the main survey was conducted simultaneously with a wider paper-based survey. The paper-based survey not only included socio-demographic questions, but also asked questions about the participant's perceived performance of the irrigation system since participatory irrigation was instigated. This survey also gained an assessment of the respondent's assessment of their overall knowledge of local water governance. The data from this survey were later linked to the responses in the choice experiments (DCE 1 and DCE 2).

5.2. DCE Designs

In the pre-testing phase, an orthogonal design was employed. This was updated in the full survey. In DCE 1 a Bayesian efficient design was employed, based on priors of the parameters derived from an analysis of the pre-test data [30]. A total of 36 choice sets were employed, blocked into 9 sets of 4 questions. For DCE 2, because of the reduction in attributes that followed the pre-test, it was possible to employ a full factorial design of 36 choice sets. The statistical software Ngene was used to generate the experimental designs for both choice experiments in the final survey (the Ngene code employed is available from authors on request).

An example choice set for DCE 1 and DCE 2 is included in Figures 2 and 3, respectively. To reiterate, these data were collected via tablets that automatically populated some information. More specifically, when the respondent self-reported the current conditions the status quo levels (i.e., option 1) was automatically populated. This varied within jurisdictions, reflecting how local rules had developed. The status quo (option 1) was also subsequent used in the statistical analysis, as outlined in Section 7.

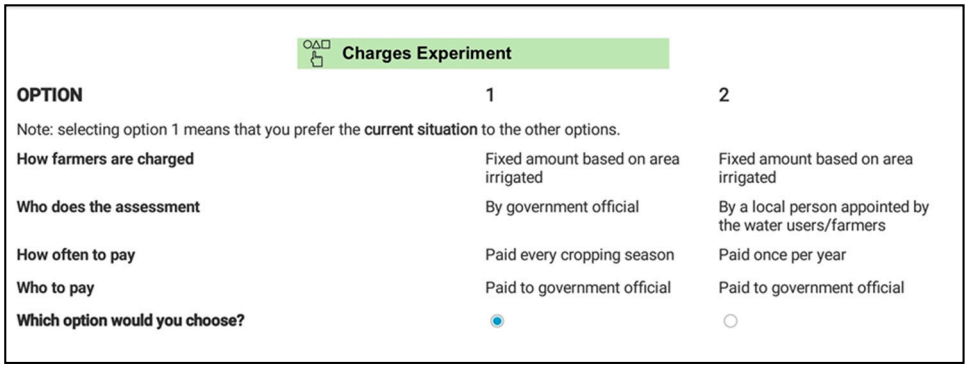

Figure 2. Example choice set: DCE 1.

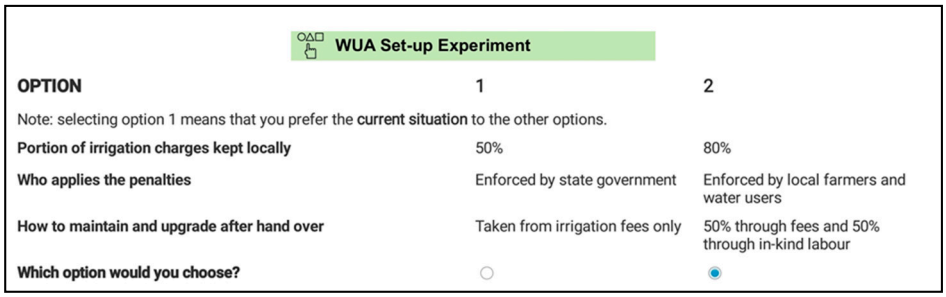

Figure 3. Example choice set: DCE 2.

6. Survey Administration and Sample

The main survey was conducted face-to-face by field enumerators using mobile tablets to support data entry. As noted earlier, the survey team in India was recruited and trained by IIM-A. The teams in Pakistan were recruited from the Mehran Institute for Technology and Engineering (in the case of Sindh) and the University of Agriculture in Faisalabad (in the case of Punjab). The ambition was to use locally-respected groups who could elicit honest responses and limit yea-saying. The sample for the experiments was drawn from farm households in Assam, Bihar, Punjab and Sindh. The sampling frame was designed as part of a broader investigation into the performance of participatory irrigation and is described in detail in Gandhi et al. [31] and Ahmad et al. [32]. This approach used information from government officials in each region around the relative functional effectiveness of local governance. More specifically, government officials nominated districts that exhibited differing acceptance of participatory irrigation management and with a variety of supply reliabilities (reflected in head, middle and tail reaches). Districts with differing histories were also included. This was expected to give some variation within the data to identify salient influences and to unpack preference-related information.

The survey was initially targeted at approximately 200 respondents from each jurisdiction, which was anticipated to provide a sample of sufficient size and diversity to generate valid empirical models. The final sample comprised a total of 819 respondents, including 196 from Bihar; 198 from Assam; 252 from Punjab; and 173 from Sindh.

7. Results of Modelling

7.1. Level of Understanding: India and Pakistan

An important consideration was the degree to which respondents understood the process by which their local Water User Association or Village Level Committee (WUA/VLC) operates. Table 3 below gives the distribution of knowledge about their WUA/VLC for each sample. Punjab and Sindh are notable in having a relatively low level reporting complete understanding, at least on the basis of these data.

Table 3. Self-reported rate of knowledge of their local Water User Association or Village Level Committee (WUA/VLC) (%).

Jurisdiction	Incomplete and Poor	About $\frac{1}{4}$ Complete	About $\frac{1}{2}$ Complete	Mostly Complete	Complete
Bihar (n = 196)	11	14	27	15	33
Assam (n = 198)	0	1	19	48	33
Punjab (n = 252)	7	15	60	17	1
Sindh (n = 173)	5	9	35	46	5

What is also of importance is the degree to which there is compliance with the payment of irrigation fees. If it is the case that farmers do not pay the fees (or seldom pay), then their assessment of hypothetical changes in the program may also be affected.

Table 4 below reports the (self-reported) rate of payment of irrigation fees, by region. Assam shows the highest rate, but there are significant numbers who are reporting that they comply only "mostly" with the requirement.

Table 4. Level of self-reported assessment of compliance with payment of fees (%), by jurisdiction.

Jurisdiction	Never	About $\frac{1}{4}$ of Time	About $\frac{1}{2}$ of Time	Mostly	Always
Bihar (n = 196)	7	7	37	44	5
Assam (n = 198)	0	0	0	19	81
Punjab (n = 252)	0	3	16	44	37
Sindh (n = 173)	1	1	5	60	35

We find that there is some degree of correlation between levels of compliance and responses to the discrete choice experiments, as reported below.

7.2. DCE 1: Payment Methods

Prior to the statistical analysis of the responses to the DCE questions it is important to identify if respondents are considering the choice tasks in a compensatory manner i.e., if they are considering the levels of attributes and making a considered evaluation of the alternatives. A common form of contrary behaviour is denoted protest behaviour. In the current context a protesting respondent was one who selected the status quo in all 4 questions presented, and then selected particular answers in the debriefing questions as to why they followed this behaviour. Not all cases of repeated selection of the status quo would be deemed protest behaviour: selection of an appropriate response (e.g., indicating that the status quo was the preferred option) would mean the respondent would be considered as making compensatory choices.

Table 5 below reports the number of protest respondents identified for the DCE experiment, by region, and the reason given for the behaviour. Protest behaviour was particular prevalent in Punjab and Sindh, with 31% and 50% respectively.

Table 5. Number of "protest" respondents, and reasons given for behaviour, by region.

Protest Question	Bihar (n = 196)	Assam (198)	Punjab (n = 252)	Sindh (173)
I would like to change the payment method, but I am unsure about the other options	15	44	4	8
I would like to have a different payment method, but the government should decide	0	0	55	19
I found it too hard to compare the options, so I selected the SQ	2	2	11	8
I would like to have changed the payment system, but I do not trust the government to deliver it	0	4	8	51
Total protestors	17	50	78	86

7.2.1. India: Bihar and Assam

Tables 6 and 7 report estimates from the discrete choice models for the Indian samples. We have explored the extent to which self-reported non-payment of fees has influenced choices. We define a new variable, *nopay*, which takes a value from 0 to 1, which is a rescaling of the 5 point index reported in Table 4 above, such that it takes a value of 0 if farmers always pay irrigation fees and 1 if the never pay, with a linear interpolation between them. This variable is interacted with the status quo dummy variable i.e., we hypothesize that those who do not pay fees may have differing preferences for whether the charging process should change.

Table 6. Conditional logit estimates for preferences for irrigation payment systems: Bihar.

Bihar	Levels	Coeff	SE	*p*
Basis of charging	Crop	0.246	0.191	0.198
(base = Area)	Both	0.325	0.198	0.100
Assessment Method	Water user	0.295	0.211	0.161
(base = Gov official)	Jointly	0.564	0.206	0.006
Payment method	Annually	−0.151	0.130	0.246
(base = Seasonally)				
Collection method	Water users	0.015	0.205	0.942
(base = Gov official)	Jointly	0.101	0.204	0.623
Status quo		0.645	0.267	<0.001
Status quo × *nopay*		−2.071	0.354	<0.001
Choices	716			
Individuals	179			

Table 7. Conditional logit estimates for preferences for irrigation payment systems: Assam.

Assam	Levels	coeff	SE	*p*
Basis of charging	Crop	−0.353	0.197	0.073
(base = Area)	Both	0.429	0.237	0.069
Assessment Method	Water user	−0.344	0.299	0.249
(base = Gov official)	Jointly	0.591	0.270	0.029
Payment method	Annually	−0.540	0.175	0.002
(base = Seasonally)				
Collection method	Water users	−0.123	0.269	0.648
(base = Gov official)	Jointly	−0.053	0.282	0.850
Status quo		1.806	0.278	<0.001
Status quo × *nopay*		6.861	1.928	<0.001
Choices	592			
Individuals	148			

For Bihar, there is relatively little that explains the choices made. Only a shift from government to joint assessment increases the likelihood of accepting a change. The status quo effect (which is a representation of the utility of selecting their current situation) is positive for those who always pay their fees (i.e., when *nopay* = 0) but that shifts to a negative value when *nopay* rises to its maximal level (1) when they never pay. The implication is that those who never pay are more actively looking for changes in charging methods, but there is little in the results to indicate what type of change they would prefer. In Assam, the reverse is true: those who pay less frequently have a stronger preference for

maintaining the status quo than those who always pay. Again, there is relatively little in the estimates that indicates strong references for the design of a new system: a preference for joint assessment and annual rather than seasonal payments.

7.2.2. Pakistan: Punjab and Sindh

The results for Punjab and Sindh are reported in Tables 8 and 9 below. Here, for the Punjab respondents, only the basis of charging shows any significant effects, with an Area based approach being preferred to one based on crops, or a combination of the two. The effect of not paying fees is present in the estimate of the status quo, with those who do not pay fees having a significantly higher preference for the current situation. In the Sindh, there is no effect of payment frequency on preference for the status quo, and there is a diversity of significant effects identified: charging on the basis of both area and crop is preferred to either single approach, having government officials undertaking assessment is seen as worse than the assessment being conducted by water users or a joint approach, and water users collecting fees is preferred to any system involving the government.

Table 8. Conditional logit estimates for preferences for irrigation payment systems: Punjab.

Punjab	Levels	Coeff	SE	*p*
Basis of charging	Crop	−0.841	0.269	0.002
(base = Area)	Both	−0.569	0.254	0.025
Assessment Method	Water user	0.270	0.284	0.343
(base = Gov official)	Jointly	0.219	0.290	0.450
Payment method	Annually	−0.260	0.228	0.254
(base = Seasonally)				
Collection method	Water users	0.347	0.253	0.170
(base = Gov official)	Jointly	0.080	0.268	0.766
Status quo		0.279	0.282	0.321
Status quo × *nopay*		1.671	0.580	0.004
Choices	632			
Individuals	158			

Table 9. Conditional logit estimates for preferences for irrigation payment systems: Sindh.

Sindh	Levels	Coeff	SE	*p*
Basis of charging	Crop	−0.229	0.271	0.399
(base = Area)	Both	−0.833	0.360	0.021
Assessment Method	Water user	1.297	0.279	<0.001
(base = Gov official)	Jointly	1.360	0.344	<0.001
Payment method	Annually	−0.202	0.211	0.339
(base = Seasonally)				
Collection method	Water users	0.768	0.241	0.001
(base = Gov official)	Jointly	−0.371	0.351	0.291
Status quo		1.674	0.313	<0.001
Status quo × *nopay*		−0.351	0.896	0.695
Choices	348			
Individuals	87			

7.3. DCE 2: Governance of Irrigation

As with the DCE 1 experiment, responses were checked for protest behaviour, and those who selected the status quo in all 4 questions and gave specific answers to the debrief questions were identified as "protest" respondents and excluded from the statistical analysis. A summary of responses is given in Table 10 below.

Table 10. Number of "protest" respondents, and reasons given for behaviour, by region.

Protest Question	Bihar (n = 196)	Assam (198)	Punjab (n = 252)	Sindh (173)
I would like to change the setup, but I am unsure about the other options	10	19	8	9
I would like to have a different setup for water users, but the government should decide	2		55	14
I found it too hard to compare the options, so I selected the SQ		2	8	7
I would like to have changed the setup for water users, but I do not trust the government to deliver it		2		44
Total protestors	12	23	71	74

7.3.1. India: Bihar and Assam

In these models the degree of payment compliance is associated with the level of local revenue retained at the local level. It is anticipated that if one is actually contributing fees, that one may have a different preference for where that money goes (we also tested for an interaction with the status quo, but in no cases was that effect significant). For Bihar, those who always pay have a preference for higher levels of revenue being held locally. As the level of compliance falls, then that effect reduces and invert: those who never pay would prefer to see less revenue held at the local level. There is also a preference for the irrigation system to be maintained with some degree of local labour.

In Assam, a similar effect is found for the effect of paying fees on preferences for local revenue, although it is noteworthy that in this sample, respondents had a much higher level of compliance, so no respondent in the sample would ever prefer there to be less local revenue. No other factors influenced choices and the related conditional logit models are reported in Tables 11 and 12.

Table 11. Conditional logit estimates for preferences for governance structures: Bihar.

Bihar	Levels	Coeff	SE	*p*
Local Revenue		0.037	0.006	<0.001
Local Revenue × *nopay*		−0.074	0.013	<0.001
Sanctions	Local	−0.193	0.180	0.286
(base = state)	Jointly	−0.083	0.190	0.661
Irrigation system	Local labour	−0.701	0.204	0.001
(base = local cash)	Cash & labour	−0.494	0.195	0.011
	Local and state	−0.267	0.224	0.233
Status quo		−0.313	0.177	0.077
Choices	736			
Individuals	184			

Table 12. Conditional logit estimates for preferences for governance structures: Assam.

Assam	Levels	Coeff	SE	*p*
Local Revenue		0.017	0.004	<0.001
Local Revenue × *nopay*		−0.080	0.020	<0.001
Sanctions	Local	0.018	0.206	0.929
(base = state)	Jointly	−0.000	0.211	0.999
Irrigation system	Local labour	−0.017	0.212	0.935
(base = local cash)	Cash & labour	−0.453	0.140	0.001
	Local and state	0.309	0.239	0.197
Status quo		−1.368	0.239	<0.001
Choices	700			
Individuals	175			

7.3.2. Pakistan: Punjab and Sindh

Within the Pakistan samples, there is no effect of payment compliance on preferences for the level of local revenue retained. In Punjab there was a strong preference for any system of maintaining the irrigation system other than that using local labour. In Sindh there was a preference for more local revenue being retained, and a preference for the use of both cash and labour in the maintenance systems. The relevant models for each province appear as Tables 13 and 14.

Table 13. Conditional logit estimates for preferences for governance structures: Punjab.

Punjab	Levels	Coeff	SE	*p*
Local Revenue		−0.012	0.006	0.053
Local Revenue × *nopay*		−0.010	0.018	0.606
Sanctions	Local	0.061	0.230	0.790
(base = state)	Jointly	0.229	0.236	0.333
Irrigation system	Local labour	−1.460	0.266	<0.001
(base = local cash)	Cash & labour	−1.596	0.260	<0.001
	Local and state	1.329	0.259	<0.001
Status quo		1.537	0.235	<0.001
Choices	656			
Individuals	164			

Table 14. Conditional logit estimates for preferences for governance structures: Sindh.

Sindh	Levels	Coeff	SE	*p*
Local Revenue		0.046	0.007	<0.001
Local Revenue × *nopay*		−0.010	0.020	0.608
Sanctions	Local	−0.016	0.200	0.934
(base = state)	Jointly	0.419	0.260	0.105
Irrigation system	Local labour	0.467	0.260	0.073
(base = local cash)	Cash & labour	0.667	0.221	0.003
	Local and state	0.551	0.330	0.095
Status quo		1.783	0.218	<0.001
Choices	396			
Individuals	99			

8. Discussion and Concluding Remarks

What is striking about these results is the diversity of outcomes across the four jurisdictions, 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 is significant in both of the India samples, but is of opposite signs. The effect is significant in Punjab but not Sindh.

Others have posited that retaining revenues locally in participatory irrigation management can engender greater compliance by farmers but simultaneously found that compliance itself requires the support of the state/provincial government (see, [22]). Similar complicated interactions are evident in this preference data.

It is notable that in the Pakistan samples there was a high level of "protest" behaviour, with between 28 and 49% of the samples in this class. This has two effects: Firstly, it will have significantly reduced the power of the experiment to identify significant effects. Secondly, it suggests a widespread view that the government should be making these choices, or that the government would not be trusted to implement the preferences of the farmers. If this perspective of dis-enfranchisement is widespread then it may also be having an impact on the choices of the remainder of the sample and reflect in relatively low levels of attributes being significant.

The fact that different attributes appear significant in each jurisdiction, while also varying, supports the view that there is some appetite for change at least. However, there is no one panacea that will satisfy all farmers in all jurisdictions. Put differently, perceived weaknesses around charging and governance of irrigation are not the same and each jurisdiction will require nuanced reform to gain greater support from farmers. Thus, whilst a national agenda around PIM might be in place in both India and Pakistan, it requires much more work by subordinate governments to make it work.

Worryingly, the level of self-reported knowledge of charging and governance within some water user and farmer organisations was lower than might be expected. In Sindh, Punjab and Bihar, at least half of the respondents indicated they had only fifty percent understanding of the rules, or less. The discord between the state/provincial rules and local interpretation may account for this response, but greater effort to communicate how charging and governance relate to irrigation outcomes appears justified.

The research team administering the choice experiment also reported consistent anecdotal evidence from farmers participating in the data gathering. More specifically, farmers noted the challenge of completing the choice sets because they had experienced few opportunities to express a real preference for payment mechanisms or irrigation governance. Rather, these decisions had always been mandated by state/provincial decree and farmers had come to expect that this top-down approach would continue. Forming their own views about alternative options was thus challenging, inasmuch as the process of preference formulation had never occurred to them. Against that background there is considerable scope for engaging more comprehensively with farmers around the design of PIM.

To the knowledge of the authors, a choice experiment elucidating farmer's preference around charging and governance in PIM has hitherto not been administered in South Asia. The data that was collected expose the challenge of achieving uniform reform. Rather, local and state/provincial agencies need greater and clearly nuanced communication with farmers. It may also help if those agencies approach the task by directly seeking farmer input in the first instance, rather than reverting to a top-down approach where local preferences are ignored.

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