

Irrigation reform in Asia: A review of 108 cases of irrigation management transfer

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Table of Contents

1. Introduction	1
2. Research questions and objectives	4
3. Methodology	5
3.1 Selection of case studies	5
3.2 Coding	7
3.3 Construction of composite success score	10
3.3.1 Definition of success	10
3.3.2 Indicators of success	10
3.3.3 Construction of composite success score (CSS)	13
3.3.4 Robustness of CSS	14
4. Critique of case studies	14
4.1 Bibliographic information	15
4.2 Critique 1: Method of analysis used	16
4.3 Critique 2: Lack of independent verification of impacts and outcomes	17
4.4 Critique 3: Dearth of long term impact assessments	17
4.5 Critique 4: Lack of consensus on definition of success	18
5. Evaluation of IMT/PIM cases using composite success scores (CSS)	18
5.1 Managing common pool resources	21
5.2 Finding patterns in success	23
5.2.1 Success by type of irrigation scheme	23
5.2.2. Success by size of the scheme	23
5.2.3 Success by complexity of the scheme	25
5.2.4 Success by type of crop grown	25
5.2.5 Success by age of system and rehabilitation before transfer	26
5.2.6 Success by level of management transfer	28
5.2.7 Success by training before transfer	30
5.2.8 Success by type of implementing agency	30
5.2.9 Success by representativeness of WUAs	31
5.2.10 Success by overall economic condition of the country	32
5.2.11 Success and other factors	33
5.3 Results of logistical regression: What determines success?	33
5.4 Unpacking success and failure: Some qualitative insights	34
5.4.1 Qualitative analysis of cases of outstanding success	35
5.4.2. Qualitative analysis of cases of complete failure	36
6. Re-examining the conceptual underpinnings of IMT/PIM policy in Asia	37
6.1 Shaping of IMT policy: Assumptions versus reality	37
6.1.1 Deferred maintenance: a donor-driven problem definition?	37
6.1.2 Conceptual transformation of FMIS into WUA	38
6.1.3 Farmers-agency relationship in IMT	40
6.2 Paradoxes in IMT policy	41
7. IMT as a policy deadlock: What's next?	42
7.1 Public private partnerships (PPP) in irrigation sector	43
7.1.1 Examples of PPP in Irrigation and Drainage Sector in Asia	44
7.1.2. Lessons from Asian cases of PPP in I& D sector	46
7.2 Reform or morph: Responding to the changing socio-technical foundations of Asian irrigation	46
8. Conclusion	49
References	50
Appendix 1 Bibliography of Case Studies in Asia	53
Appendix 2 - Location and identification details of the case study	57
Appendix 3 - Methodological indicators	65
Appendix 4 - Technical specification of the schemes	79
Appendix 5 - Socio-economic and agricultural characteristics of the schemes	86
Appendix 6 - PIM and IMT related indicators	96
Appendix 7 - Outcome and impact indicators and Composite Success Score (CSS)	104

List of Tables

Table 1 List of outcome and impact indicators used for construction of success scores	11
Table 2 Comparison of author's evaluation of success with our Composite Success Score	14
Table 3 Some oft cited indicators of success	18
Table 4 Composite success score of IMT/PIM intervention in different countries	19
Table 5 Critical factors determining success of common property management regimes	22
Table 6 Logit using observations 2-108 (n=46); Dependent variable: SUCCESS	34
Table 7 Cases of outstanding success and complete failure	35
Table 8 Organizational distinction between FMIS and WUAs	39
Table 9 Examples of PPP in I&D sector in Asia	45
Table 10 Socio-technical context of surface irrigation in different eras	47
Table 11 Socio-technical environment of Asia's surface irrigation systems	48

List of Figures

Figure 1 Schematic diagram of different levels of IMT	2
Figure 2 Distribution of case studies across regions in Asia	6
Figure 3 Location of case studies across Asia	7
Figure 4 Complex and simple irrigation systems	8
Figure 5 Number of cases for which data was available (max=108)	9
Figure 6 Number of indicators per case study	10
Figure 7 Number of case studies for which outcome and impact indicators were found (max=108)	12
Figure 8 Number of outcome and impact indicators per case study	13
Figure 9 Frequency distribution of composite success score	14
Figure 10 Distribution of case studies across the years, 1995-2009	15
Figure 11 Type of publication from which our case studies have been sourced	16
Figure 12 IWMI vs. non-IWMI case studies	16
Figure 13 Method of analysis used by case study authors	17
Figure 14 Classification of case studies according to period of evaluation	18
Figure 15 Distribution of successful and failed cases of IMT/PIM	20
Figure 16 Success and failure by period of evaluation	20
Figure 17 Performance of case study systems in terms of outcome and impact indicators	21
Figure 18 Success and failure by type of irrigation scheme	23
Figure 19 Categorization based on the size of the systems	24
Figure 20 Success and failure by size of turned over system	24
Figure 21 Success and failure by number of farmers served	25
Figure 22. Success and failure by complexity of irrigation scheme	25
Figure 23. Success and failure by type of crop grown	26
Figure 24 Success and failure by age of the system	27
Figure 25 Rehabilitation of system before transfer	28
Figure 26 Success and failure by rehabilitation	28
Figure 27 Highest hydraulic authority transferred	29
Figure 28 Level of O&M authority transferred to the users	29
Figure 29 Success and failure by highest hydraulic unit transferred	30
Figure 30 Success and failure by level of O&M authority transferred	30
Figure 31 Success by type of implementing agency	31
Figure 32 Success and failure by representativeness of WUAs	32
Figure 33 Relationship between per capita GDP of countries and CSS	32

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"Happy families are all alike; every unhappy family is unhappy in its own way"

Leo Tolstoy in Anna Karenina

1. Introduction

Like the proverbial happy families of Tolstoy, it is thought that all successful water users associations (WUA's) have intrinsic commonalities and once these are understood, WUAs can be engineered for success. A large body of literature has been devoted to understanding the factors that make or break cooperative strategies in the field of natural resources management (NRM) in general and WUA's in particular. The purpose of this paper is to contribute to this body of literature by contesting the view that successful WUAs can be engineered. We argue that successful cooperative action in large scale public irrigation systems takes place under a set of very context specific and process intensive conditions – conditions that are difficult and costly, if not impossible to replicate elsewhere. We also argue that lack of replicability of successful cases of IMT is not an issue of poor implementation or enabling conditions, as it is generally thought (FAO, 2007), but is related to conceptual weakness of the IMT model itself.

We make our case by reviewing 108 studies of WUAs in public irrigation systems. These irrigation systems, or parts of them, have been turned over by the government to the farmers for management. Our paper responds to the need for evaluating the performance of irrigation management transfer (IMT) and participatory irrigation management (PIM) that has been the buzzword among, researchers, development practitioners, donors and governments alike for the last three decades or so.

There are at least two characteristics that are shared by most irrigation systems. First, irrigation systems are common pool resources (CPRs) characterized by twin principles of non-exclusion and subtractive consumption¹ (Ostrom 1990:32). Second, most irrigation infrastructures are highly asset specific² (Tang 1992:17). Implications of irrigation systems being a CPR are two, viz. there is a problem of provision (who will provide?) as well as problem of allocation (who will manage?), while the implication of the asset specificity is that once the irrigation infrastructure is created, it is almost impossible to redeploy it to other uses, making it necessary to ensure that allocation problem is somehow taken care of.

These intrinsic characteristics of irrigation systems were realized long ago and governments of most countries decided to provide irrigation infrastructure and also manage them for public benefit. Most governments, to some extent, could take care of problem of provision through creation of infrastructure and designating an authority to manage it³. However, they failed in effectively solving the problem of

¹ Non exclusion means that it is very difficult, though not impossible to exclude potential beneficiaries, while subtractive consumption means that one individual's use of the resource diminishes the amount of resource others can use. Both these hold true for any irrigation system, particularly canal systems. Once built, it is well nigh impossible to prevent farmers to use water if it happens to flow through their fields or near their fields. Similarly, a head end farmer using more than his share of water subtracts the amount of water a tail ender gets.

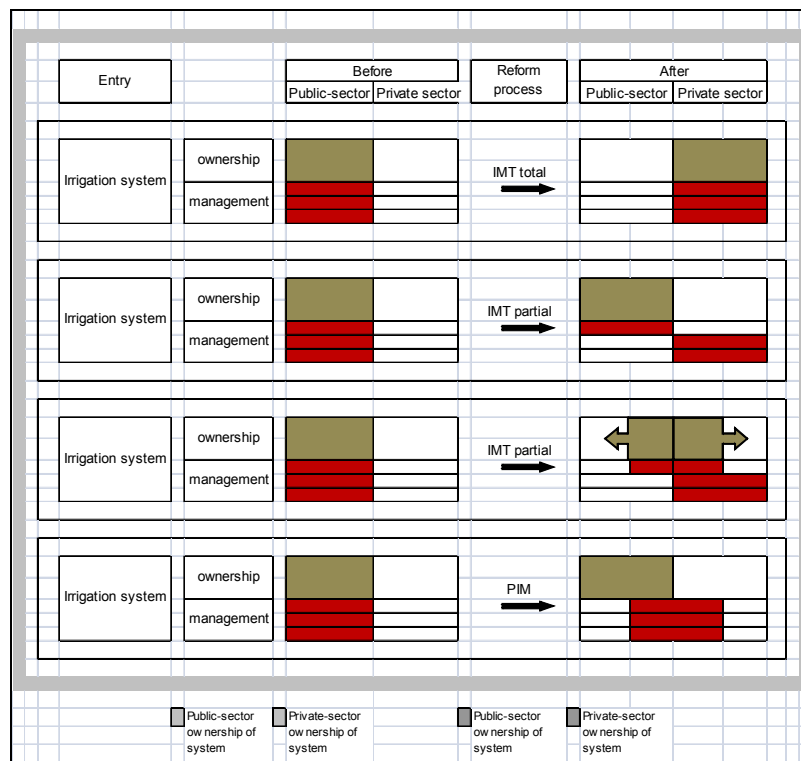
² Asset specificity has been defined by Williamson (1985:55) as "...durable investment that are undertaken in support of particular transactions, the opportunity cost of which investment is much lower in best alternative uses or by alternative users should the original transaction (were to) be prematurely terminated." In case of irrigation infrastructure, it means if the design is poor or inappropriate, you are stuck with it.

³ Many however contend that governments have done an equally poor job in solving the problem of provision, other than constructing the infrastructure and formally assigning responsible government agency for the task. In practice, water service provision is the core management problem in almost government-managed irrigation systems. This is also one of the main critiques of IMT that it fails to address the provision problem (technically, organizationally and institutionally).

proper allocation⁴. Too many schemes underperformed: physically, economically and financially. It was therefore realized that bureaucratic management of irrigation systems was not the best solution. Similarly, outright privatizing of irrigation systems, though perhaps right for the developed countries (see Farley 1994 for the case of New Zealand) did not seem to be an option for most of the lesser developed or developing ones. It is in this context that governments in many countries, with advice from major donors such as the World Bank and the Asian Development Bank (ADB) decided to turn over irrigation management to user groups. This was also seen as a convenient way out for the public agencies crippled with huge financial burden from the irrigation sector. The process whereby authority and responsibility to manage irrigation systems is transferred from the government to the water user's associations (WUAs) or private entities is called Irrigation Management Transfer (IMT).

There are various degrees of IMT, ranging from total IMT (or full privatization), where ownership of the irrigation asset as well as the management function are transferred to the users, to partial IMT, where the ownership of the asset is retained by the government or shared with the users, while the management functions are transferred to the users. When, management function is transferred to a representative farmer's organization, most often a water user's association (WUA) (as against a private contractor or firm) and farmers are expected to participate actively in WUA's activities, the reform process is called Participatory Irrigation Management (PIM). PIM is frequently used to achieve IMT, especially at the co-management phase of IMT, when the management of the system is shared between the public sector agencies and some entity that represents the users (Garces-Restrepo, Vermillion and Muñoz 2007). In much of Asia, PIM has been the only way used to achieve IMT and therefore, in our review, we will use the two terms interchangeably. Figure 1 shows a schematic diagram of the different degrees of IMT and is based on FAO, 2007.

Figure 1 Schematic diagram of different levels of IMT



Source: FAO, 2007

⁴ Perhaps, current failure to solve the problem of proper allocation is rooted in the problem of provision, that there is no clear task division in the present 'service' arrangement. Formally, it is expected that the government agency will provide water to the farmers. But in practice, this is not always the case. Similarly, formally, it is expected that irrigation agency will maintain the infrastructure, as to be able to provide water to farmers. Yet, in practice, deferred maintenance problem shows that the agency not carrying out its maintenance functions properly (and not without reason).

There are three theoretical assumptions behind IMT, assumptions, that we contend, have not been unpacked properly. First, it is assumed that because traditional self governed irrigation systems have endured, therefore, WUAs in modern canal systems too will. Second, it is thought that most of these public systems have potential to be financially and economically viable, but government management is not the ideal way to achieve this. Third, it is assumed that resource users (i.e. the farmers) are ideally suited to manage these systems, because they have the largest stake in long term sustainability of the resource.

Hunt (1989:79-96) questioned the first assumption by pointing out that the traditional irrigation institutions are not analogous with WUAs in public irrigation systems. The second assumption about intrinsic financial and economic viability too does not seem to hold good in many instances, because many irrigation schemes in post colonial Asian countries were justified on grounds of social cost benefit ratio rather than economic cost benefit one. In other words, unlike the colonial times, when viability of the irrigation scheme was decided on commercial grounds, in post-independent era, irrigation schemes were constructed with the aim of achieving food self sufficiency with much less attention paid to their commercial viability. Finally, the third assumption is the most contentious. It is assumed that because farmers have the largest stake, they will come forward and manage a part of the irrigation system. This in turn assumes that all farmers have equal stake in management or in other words, the private interest of all farmers are same and equal in intensity. Thus, all the complexity involved in moving towards a co-operative strategy and sustaining it endlessly was underplayed. This assumption is also contested on other grounds. It has been pointed out that the “urban bias” displayed in maintaining low food prices meant that farmers were after all, not the main beneficiary or stakeholder of the irrigation schemes. In many countries, farmers have been implicitly taxed for their farming activities and hence the assertion that they would have the highest stake in managing irrigation systems may be further from truth than often understood.

In spite of assumptions that are clearly questionable, governments and donors have been pursuing IMT/PIM for over 30 years now. Hundreds of case studies, “how to do” IMT/PIM manuals, impact evaluation assessments and reports have been written. In 1994, there was a stock taking of progress in IMT/PIM at an international conference at Wuhan, China. However, after years of research into IMT/PIM, it is still one of the most contentious issues in irrigation and we are far from any consensus on whether or not IMT/PIM has been successful in meeting its objectives. Global experience with IMT/PIM has been at best mixed and views vary widely. Shah et al. (2002) in a succinct review of literature on IMT contended that it has worked in situations “where irrigation is central to a dynamic high performing agriculture...” (Shah 2002:3) and benefits from managing the system far outweighs the costs of management (including transaction costs), partly because irrigation costs constitute a small proportion of added income. He concluded that failures are far more common than successes. Many others posit that there have been highly successful cases of IMT/PIM in Asia and that we need to learn from those successes and replicate them elsewhere. Indeed, there is an organisation, namely, the International Network for Participatory Irrigation Management, whose mandate is to promote PIM. International donors have been at the forefront of promoting IMT/PIM as the institutional solution to irrigation problems. IWMI, in its early years, was one of the most vocal proponents of IMT and PIM.

However, much of the advocacy work on IMT/PIM is done with patchy evidence at best and lack of any at worst. This is because; there are very few comprehensive and methodologically rigorous evaluations of IMT and PIM, even though there are numerous studies of individual cases. The quality of these case studies is also questionable in terms of method and rigor, as we shall point out later in this report.

Thorough search of the literature yielded only two comprehensive evaluations of IMT/PIM so far. Responding to the need to provide a review of impact of IMT/PIM, Vermillion undertook the first evaluation of IMT in 1997. Using data from 29 case studies, he attempted to evaluate the impacts of IMT on financial and managerial performance; the physical sustainability of the irrigation systems; agricultural and economic productivity and the environment. He concluded that impact of IMT reforms cannot be drawn clearly because of lack of systematic sampling and limited extent of “before and after” analysis. He suggested that further research is needed to delineate common characteristics of the successful cases (Vermillion, 1997).

More recently, FAO (2007), in collaboration with IWMI, published a comprehensive review of IMT. The report presented the results of a six-year-long research project, during which data on IMT in 34 countries were collected and analysed. They evaluated performance based on a set of impacts and outcome

indicators, but stopped short of quantifying them. They concluded that worldwide experience with IMT shows that it produced a mix of successes and failures. The report found that the major constraints in terms of implementation were the lack of political support for IMT by the government, of suitable legislation and of suitable managerial skills within the WUAs. However, they present only country level assessment and hence paint a broad brush picture without capturing the within country variations.

Our report intends to fill in some of the gaps left in the previous reviews. For one, with 108 case studies from 20 countries in Asia, ours is, to the best of our knowledge, the most comprehensive database on IMT/PIM cases in Asia. FAO (2007) covers only 11 countries from Asia. Unlike the FAO (2007), but like Vermillion (1997), we look only at localised (and few regional) case studies of IMT/PIM and hence are able to provide a rich source of information on the socio-economic, political and cultural context of IMT/PIM. Second, ours is a much larger database than Vermillion's and is amenable to statistical analysis. This allows us to evaluate success and failure of IMT/PIM intervention by assigning a specific score to each one of the case studies and draw concrete conclusions using a mix of qualitative and quantitative techniques. All the case studies, coding sheets and the results are publicly accessible ([insert knowledge hub website address](#)). This work has been done as a part of the ADB commissioned research of Future of Irrigation in Asia.

This report is divided into eight sections. After the introductory section, section 2 delineates the research objectives and questions. Section 3 outlines the method used in this study, while section 4 critiques the case studies in terms of their method and rigor. Section 5 discusses success and failures in IMT/PIM and the factors that might explain those using descriptive statistics and regression analysis. It specifically looks at highly successful cases of IMT and unpacks the factors that might have led to that success and speculates on whether or not those factors are replicable across locations. Section 6 draws upon the findings of section 5 and critically examines the conceptual underpinnings surrounding the discourse on IMT/PIM in Asia and elsewhere. Section 7 talks of ways forward and tries to examine if public private partnerships (PPP) in irrigation management is an option for Asian economies and if so, where are those most likely to succeed. It also discusses the need for a more radical paradigm shift in our thinking on irrigation management reform. We conclude our report in the 8th and the final section.

2. Research questions and objectives

The goal of this research is to present a state of the art review on IMT/PIM in Asia. In order to achieve this goal, we have five research questions. These are:

1. How well have the impacts and outcomes of IMT/PIM in Asia been documented so far and what have we learnt from those studies?
2. How can we evaluate the impact and outcomes of IMT/PIM and differentiate the successful cases from 'not so successful' ones?
3. What are the conditions under which successful WUAs in public irrigation systems are found? Are those conditions replicable?
4. How well grounded are the conceptual underpinnings surrounding the IMT/PIM discourse?
5. What if the current paradigm of IMT/PIM yields less than expected results? What then are the ways forward?

For answering research question 1, we systematically analyzed all 108 case studies in terms of their method and rigor. The results are presented in section 4. For answering question 2 and 3, we developed a methodology for evaluating each of our cases on a uniform scale of 0 to 10. These were classified into successful and failed cases of IMT/PIM. Success/failure was then related to individual characteristics of the case studies in order to cull out the common factors of success and see if those are replicable elsewhere. However, it is important to mention here that our intention is not find a recipe of success, as it were. It is now widely acknowledged that it is not possible to design an IMT model that can cater to different physical, institutional, socio-economic and cultural conditions and hence the search for the ideal model is futile. Our intention is simply to find out if IMT/PIM worked and if so, why and under what conditions. Results are presented in section 5.

A reading of IMT/PIM literature conveys that assumptions behind these have rarely been unpacked and we think it is necessary to analyze the conceptual underpinnings of IMT/PIM *per se* in order to understand the full implications of our findings. We do this in section 6. Finally, we ask, if there are alternatives to IMT/PIM and if yes, what are they and what are their pros and cons. We do this in the 7th section of the paper.

3. Methodology

Given the objectives of this paper, a three step method of analysis was adopted. These steps were: selection of case studies, coding of the case studies based on the institutional analysis and development (IAD) framework and finally, developing a composite success score (CSS) for evaluating each of the case studies and classify them as successful or failed cases of IMT/PIM. Our approach is what Potetee & Ostrom (2007) call building large N databases based on qualitative research. It also responds to the plea by Agrawal (2001:1649) for “careful research design and sample selection, construction of causal mechanisms, and a shift toward comparative and statistical rather than single case analyses” which he thinks is necessary for developing a better theory of the governance of the commons. Thus, the thrust of our methodology has been to use the descriptive richness of individual case studies by coding a large number of them (N=108) within a common framework and derive statistical generalisation from them.

3.1 Selection of case studies

This review focuses exclusively on Asia and therefore the first step was selecting case studies on PIM/IMT from the Asian continent. A general search of some of the major databases including Water Resources Abstract, CAB Direct, Econ Lit, Sociological Abstracts, Scopus, FAO's AGRIS database, IWMI's catalogue and World's Bank publication was undertaken. The search was restricted by using three qualifiers:

- a) The records had to be of localized case studies of one or more Water User Association and not a country level study. We did include a few regional level studies that had enough disaggregated data for our purpose.
- b) All the case studies had to be of publicly owned irrigation systems that were later handed over to the farmers for management either as a decision of the government, donors or due to the interest of the farmers. This meant we did not include case studies of farmer managed irrigation systems (FMIS), which, unlike the turned over or transferred systems of our interest, were built and managed by the farmers themselves.
- c) Case studies that were published after 1994 were included in the search. This was because 1994 marked a watershed year in the study of IMT/PIM initiatives. It was in this year that a major conference on PIM/IMT was held at Wuhan, China. Here, more than 100 case studies were presented and later documented in 2 volumes of conference proceedings. Based on the assumption that IMT/PIM initiatives in the pre-1994 era was adequately studied and documented, we wanted to review only the post-1994 case studies so as to reduce duplication in results and make our review more up to date and focussed.

Special attention was given to make sure that all the countries in Asia were covered in the search. Our search of the major databases yielded some 130-140 relevant records that met all the conditions stated above. However, a closer reading of the case studies revealed that several of them fell short in terms of details that we were looking for while coding them (see the next sub section on coding of case studies). In our coding system, there were 20 indicators that described various aspects of the case studies. Obviously, it was unrealistic to expect that all the case studies would shed light on all these 20 indicators. However, we decided that we will include only those cases that had information on at least 10 of the indicators of our interest. Similarly, in our system of CSS (see next section) developed specifically for classifying case studies into successful or unsuccessful cases of IMT/PIM, we had 9 indicators of outcomes and impacts of IMT/PIM. Here, we made sure that our case studies yielded information on at least three of the nine indicators used to classify the case studies in terms of success and failure. Based on these two conditions, our final number of case studies was 108. These 108 case studies were from 20 countries in Asia. Of these, 18 cases were from Central Asia (Kyrgyzstan, Kazakhstan, Tajikistan and Uzbekistan), 9 were from East Asia (China and Japan), 38 from South Asia (India, Pakistan, Bangladesh, Nepal and Sri Lanka), 36 from Southeast Asia (Cambodia, Indonesia, Laos, Malaysia, Philippines, Thailand and Vietnam) and 7 from West Asia (Iran and Turkey). Figures 2 and 3 show the distribution and location of case studies across Asia. Appendix 1 gives the bibliography of all case studies.

In spite of our best attempt, the very nature of the study and the way we selected our sample means that there are biases inherent in it. For one, we could not randomly select the case studies, since the total size of the population (here, the number of case studies on IMT/PIM at a local scale in Asia published after 1994) was unknown.

Second, there is a regional bias in the sense we found maximum number of case studies from South Asia (majority of which were from India) and Southeast Asia and relatively lesser numbers from East Asia. While

higher representation of South Asia in the sample is not problematic per se, given that South Asia has the largest area under irrigated agriculture, lesser number of case studies from East Asia (specifically from China) is a cause of concern since China has the second largest irrigated area in Asia after India. We took special effort to include as many case studies as possible from China, but were thwarted in our effort because most of the papers dealing with Chinese case studies were of a regional nature lacking enough details needed for our purpose. It is also our conjecture that many of the localised case studies would have been documented in Chinese language. Indeed, one of the case studies included in our sample was in Chinese and coding was done by one of our colleagues from China. Given the time, resource and language constraints, it was not possible to do a comprehensive search for articles and papers in Chinese language.

Third, given that our main objective was to evaluate and classify the cases in terms of success and failure of IMT/PIM intervention, we think that there might be a bias towards success, as successful cases have a higher chance of documentation than cases that failed.

Fourth, another possible problem with our database is that these are snapshots of cases at one point in time ranging from 1995 to 2009. We do not have any information on current status of these schemes. It is possible that schemes classified as success cases in our analysis might as well have failed over the years or our failed cases might have turned around and become successful later on. We do not have the time or the resources needed for verifying the current status of our case study schemes. We have put all our data in the public domain (knowledge hub web address), and therefore, it should be possible for other researchers to verify the current status of the schemes, if they want to do so.

While we can do very less to overcome the inherent and possible bias in our data set, our best bet was to do a comprehensive search of all available literature (in English), which we did. To the best of our knowledge, this is the most exhaustive and comprehensive evaluation of actual IMT/PIM case studies (as against regional or national level evaluations) ever undertaken and is also the first of its kind.

Figure 2 Distribution of case studies across regions in Asia

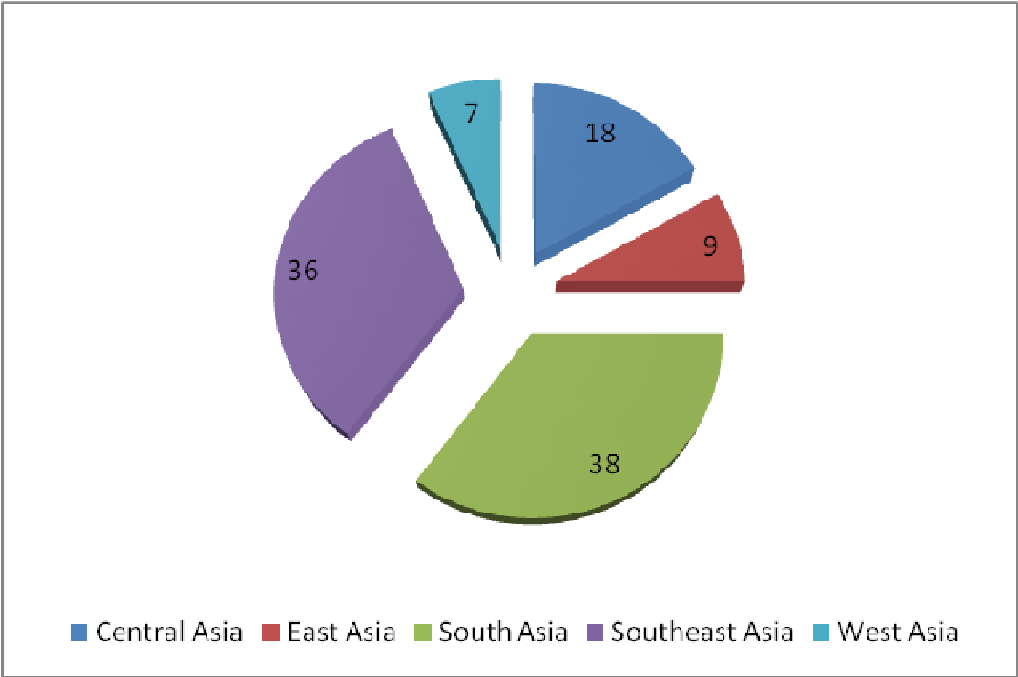
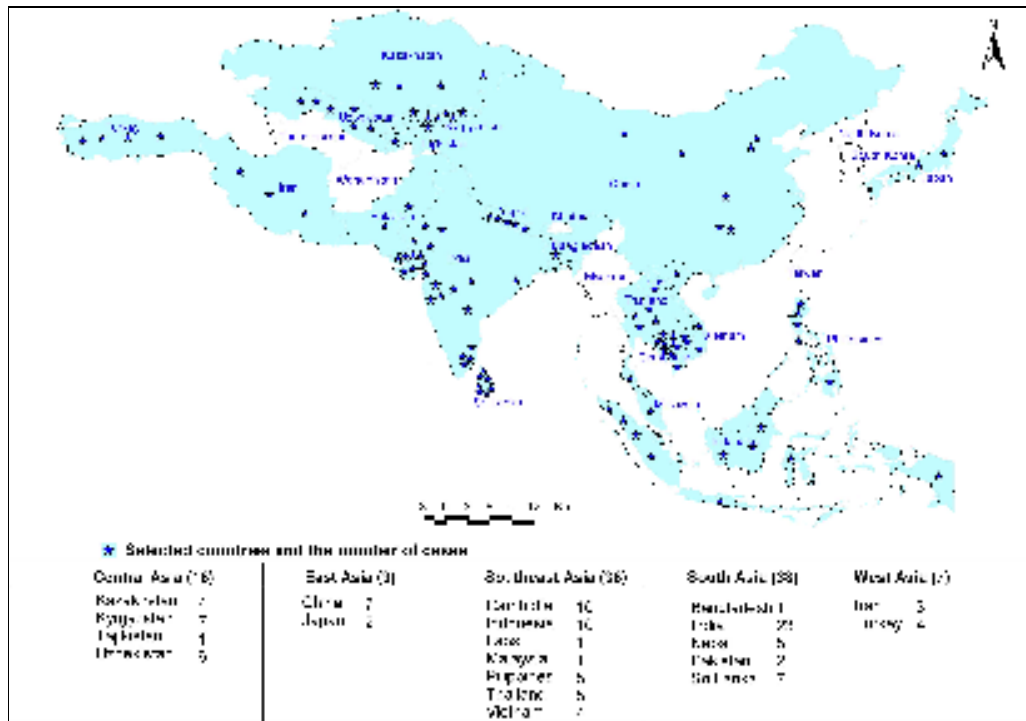


Figure 3 Location of case studies across Asia



3.2 Coding

The next step was coding the case studies based on the Institutional Analysis and Development (IAD) framework. The purpose of the coding was to make comparable a number of seemingly disparate case studies.

Tang (1992) used IAD framework to code his cases, but unlike Tang, who included both FMIS and transferred, but agency constructed systems, our sample included only the later, that is, agency constructed systems that have now been transferred to farmers for management. Drawing on various disciplines such as political science, economics, anthropology, game theory and law, researchers studying common property resources (CPR) have developed IAD framework. This framework attempts to identify “key working parts of typical situations facing participants in various circumstances” (Tang, 1992:13). Oakerson (1986) outlines a triadic interaction framework which analyzes the physical attributes of the resource, the community attributes of the people managing them and the attributes of the institutions that have been formed to manage the resource. This framework helps one to examine how rules, physical attributes and attributes of the community shape various action situations.

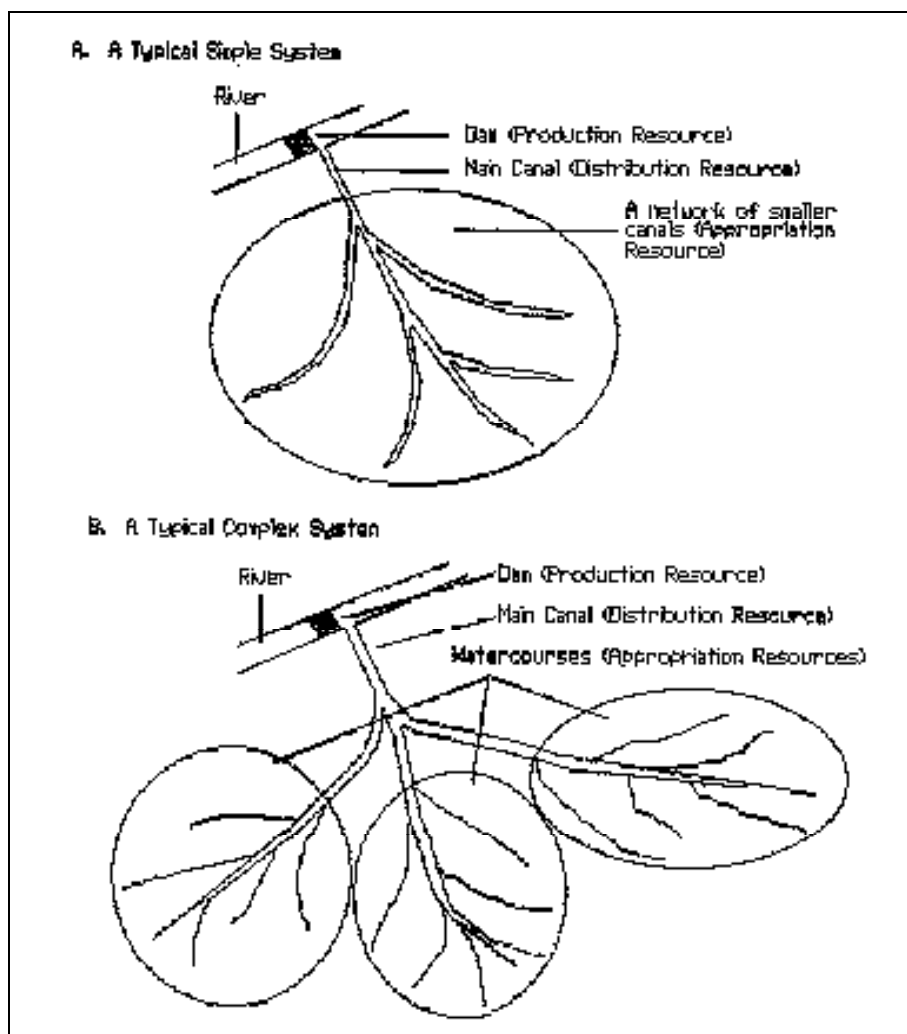
The cases were coded on several parameters and they are listed below:

1. **Location and bibliographic parameters:** These included information on name of the irrigation system; the country and province where the case study is located; the year of the publication of the case study; publication type (journal article including whether a ISI journal or not, book and book chapter, conference proceedings, donor reports, published reports and theses and unpublished reports; IWMI and non IWMI publication); authors of the case study; whether or not there were more than one source for the same case and the number of pages in each case study. Thus there are seven location and bibliographic parameters. Appendix 2 shows all the location and bibliographic parameters.
2. **Methodological parameters** including information on objectives of the case study; methods adopted (with and without, before and after, combination of with without and before after, and description without comparison); whether or not independent verification of outcomes and impacts were undertaken by the case study authors; the number of years that elapsed between the IMT/PIM intervention and the documentation of the case study and finally whose perception

(authors, farmers, irrigation officials, donors) does the author capture in the paper. There were five methodological parameters and these were then used to evaluate the quality of research into IMT/PIM in general (see Appendix 3).

3. **Parameters on technical specification** of the schemes included information on the type of the scheme (surface storage, surface diversion and surface or groundwater based pump and lift irrigation); size of the scheme (less than 500 ha = small, 500-2000 ha= medium and more than 2000 ha = large), age of the scheme and complexity of the scheme (Appendix 4). In distinguishing simple and complex systems, we considered, along with Tang's (1992) definition, a second indicator: the size of the scheme. Schemes are considered simple, if they consist of one main canal that distributes water to one canal network. Schemes with two or several main canals and watercourses were considered complex (see Fig. 4). Schemes over 500 ha were considered as complex irrespective of whether or not it consisted of one or more canal on the grounds that schemes over that size often involved more than one village and therefore became complex in terms of management and coordination. In cases, where the schemes of the case study were part of a larger system, we took the size and complexity of the large system into consideration. Even if those systems were small in size, their management would be linked to the larger system and consequently the larger system would have an impact on its management.

Figure 4 Complex and simple irrigation systems

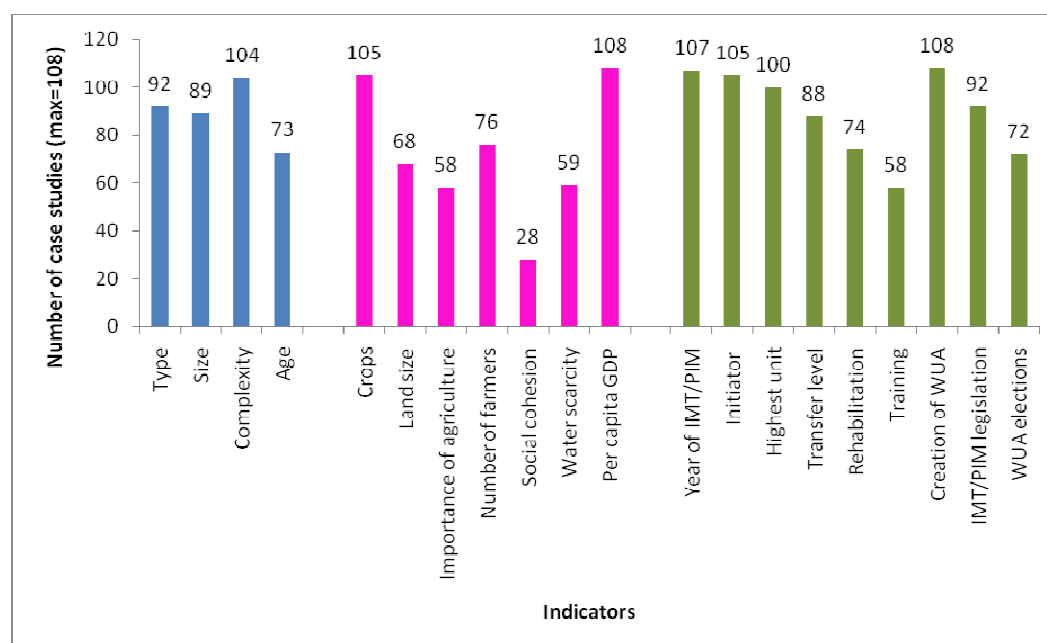


Source: Tang (1992).

4. **Socio-economic and agricultural parameters** included information on major crops grown in the case study systems (later reclassified as paddy and non paddy dominant systems), average size of landholding in hectares, importance of agriculture in livelihoods of the people (high, medium, low), number of farmers served by the system, degree of social cohesion (high, medium, low)⁵, whether the system experiences physical water scarcity and the per capita GDP of the countries in which the cases are located on purchasing power parity term (PPP). This data is taken from the latest World Development Report of 2009. There were seven socio-economic and agricultural related indicators (Appendix 5).
5. **IMT/PIM related parameters** includes information on year of implementation of IMT/PIM, initiator and or implementer of PIM (government, donor, NGO and farmers), highest hydraulic unit transferred (headworks, main and branch canals, distributary canals including secondary and tertiary canals as per the FAO, 2007 classification), amount of O& M transferred (full or partial based on FAO, 2007), if rehabilitation was done before transfer, if farmers were trained before or during transfer, if formal farmers organisations were created before transfer, if supportive legislation was enacted by the concerned government before transfer and finally whether or not the leader of the water user association (WUA) or a similar farmers' organisation in charge of managing the system after transfer was elected or not. The four indicators on rehabilitation, training, creating of WUA and supportive legislation has been also called inputs to the IMT/PIM process and it is recommended that they be carried out prior to the transfer of the system (INPIM website). In total, there are 9 PIM/IMT related indicators (Appendix 6).

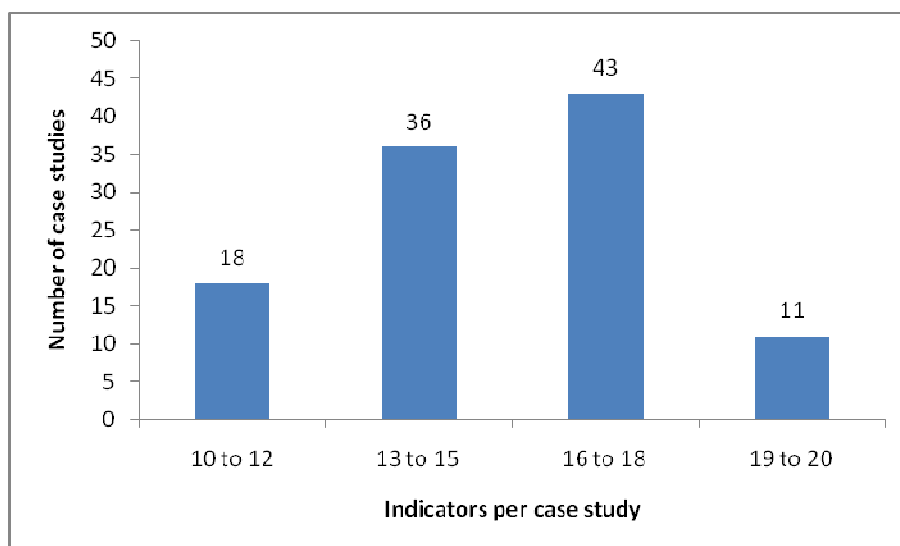
Coding on locational and bibliographic attributes were used to comment on the nature of publications, those on methodological attributes were used to evaluate the quality of IMT/PIM studies, while the 20 indicators of technical specification of the system, socio-economic and agricultural attributes and IMT/PIM implementation related attributes were used to understand circumstances under which successful and failed IMT/PIM interventions took place. Figures 5 and 6 shows the frequency distribution of each indicator for the 108 case studies and frequency distribution of the 20 indicators of our interest in each case study respectively. As already mentioned earlier, we considered only those cases which had information on at least 10 out of 20 indicators of our interest.

Figure 5 Number of cases for which data was available (max=108)



⁵ This is called social cleavage by Tang and is defined as whether or not strong class/caste and or economic and land holding size differences exists among the users.

Figure 6 Number of indicators per case study



3.3 Construction of composite success score

One of the main objectives of this review is to evaluate the overall impact and effectiveness of IMT/PIM interventions. For doing so, we needed to define what constituted a successful IMT/PIM intervention. We adopted a two stage approach in coming up with a definition of “success”. First, we reviewed all our case studies and looked at how the authors of the case studies have defined “success”. Based on authors’ evaluation, we coded each of the case studies as successful when the authors concluded it was so, failure, when the authors explicitly stated so, and inconclusive, when the authors did not give any opinion on the success or failure of the initiative. Second, we took a broader look at the IMT/PIM literature (for example, FAO review of 2007, Tang, 1992, INPIM website). We found that except for Tang (1992), who defined success in terms of only two indicators, that is, rule conformance and good maintenance, most others (including our case study authors) defined success based on a number of outcome and impact related indicators. Based on our definition of success, we constructed a composite success score.

3.3.1 Definition of success

Given that most authors seemed to agree on what a successful IMT/PIM would look like, we define IMT/PIM intervention as successful when there is a marked improvement after transfer or transferred systems fare better than non-transferred ones because *users receive adequate and reliable supply of water at reasonable and affordable costs over a sufficiently long period of time enabling them to increase their crop production, productivity and incomes.*

3.3.2 Indicators of success

For this, we measure an intervention in terms of its outcomes and impacts. The outcomes that we consider are: irrigation service fee collection rates; financial viability of WUA; functional condition of infrastructure (good maintenance); enhanced equity; reliability and adequate water supply; popular participation and reduction in disputes (or increase in rule conformance).

The impacts that we consider are include crop related impacts (increase in production, yield, cropping intensity) and livelihoods related impacts (increase in income, employment, wage rates, reduction in forced out-migration etc.). We used 9 indicators to evaluate success⁶. This list closely conforms to International Network on Participatory Irrigation Management (INPIM, see <http://www.inpim.org/>) and FAO’s (2007) definition of successful IMT/PIM initiative. Table 1 presents the list of outcome and impact indicators we used to evaluate success.

⁶ We had included an indicator on impact on government finances after transfer, but found that this information was available in less than 20 case studies and therefore was later dropped.

Table 1 List of outcome and impact indicators used for construction of success scores

Sr. No.	Name of the indicator	Scoring system	Number of cases where this indicator was present (Max=108)
A. Outcome indicators			
1.	Irrigation service fee collection rate	1= if it has gone up 0= no change or declined n/a = not available	74
2.	Financial viability of WUA	1= if it has improved 0= no change or deteriorated n/a = not available	49
3.	Functional condition of infrastructure	1= if it has improved 0= no change or deterioration n/a = not available	66
4.	Equitable distribution of water	1= if it has gone up 0= no change or declined n/a = not available	83
5.	Reliability and adequacy in water distribution	1= if it has gone up 0= no change or declined n/a = not available	76
6.	Popular awareness and participation in WUA activities	1= if it has gone up 0= no change or declined n/a = not available	87
7.	Reduction in frequency of disputes	1= Yes 0= No or got worse n/a = not available	51
B. Impact indicators			
1.	Crop related impacts (production, yields, cropping pattern, cropped area)	1= If any one of these registered an increased after transfer 0= Otherwise n/a= not available	99
2.	Livelihoods and household parameters (income, wage, employment, poverty reduction, reduction in forced migration)	1 = if any of these have gone up after transfer 0=Otherwise n/a = Not available	51

It is useful to note that we had a 10th indicator, namely, reduction in government expenditure after transfer. This has been often the main motivation for the governments to opt for management transfer. However, we found that this information was available in only 18 out of 108 case studies, making it impossible for us to use this in the construction of our composite success score.

There are obvious limitations with some of these indicators. This is particularly true for the impact indicators. Very often, increase in crop yields or area under acreage, even, if it happens after IMT/PIM intervention, may not be directly attributable to management transfer or greater farmer involvement *per se*, but may be due other factors such as better extension services, higher crop prices and so on. Studies that use “before and after” method of comparison often fail to establish causal relationship between IMT intervention and impacts. One way to overcome this problem is to combine before and after with “with and without” studies and use a difference in difference (DID) estimation strategy. But this can be seldom done due to data constraints. We found that only very few of our case studies (8 out of 108) combine “before after” with “with-without” analysis. Majority of them rely on before and after comparisons and often, simple descriptions without comparison. So, while we are aware that impacts may not be causally related to IMT/PIM intervention *per se*, there was no way to obviate this problem. Therefore, we make the rather broad assumption that positive impacts, when not otherwise stated, was indeed due to IMT/PIM. This may mean that our evaluation of IMT/PIM will appear to be more positive than might be the case.

The second concern is our subjective judgment while coding. Coding of outcomes and impacts has been straight forward enough where the case study authors explicitly state these in their papers. However, in

some cases, we had to make our own judgement in figuring out if the outcome/impact was positive, negative or neutral. In order to minimize personal bias, coding was done simultaneously by the first two authors of this report. Whenever, there was a difference in coding, it was sorted out through re-reading the text and discussions with other co-authors. This, we believe, reduced the chances of personal biases creeping into the scheme of coding. Another way to deal with this possible coding bias was to make the entire process as transparent as possible, so that in the future if any researcher wants to replicate this study, s/he may be able to access the case studies, datasheets and our coding sheets. For this purpose, we have uploaded all these information on our website and these are publicly accessible (insert knowledge hub website).

The third concern with our scoring method was that by assigning zero score to neutral as well as negative outcomes and impacts, we might be underplaying cases of failure, since negative outcomes should logically be rated lower than neutral outcomes. We tried doing this by assigning negative scores to negative outcomes, but while doing so, we found that this made the construction of our composite scoring score (CSS, see next section) more complicated. In addition, our objective is not so much to distinguish failure from neutral cases, as it is to distinguish successful from failure cases and our present scheme of scoring served our purpose.

As we have already mentioned, we accepted only those case studies that had at least 3 out of the nine indicators. Figure 7 shows the number of cases for which data for a particular indicator was available. We can see that we had relatively less information on financial viability of the WUA's, reduction in conflicts vis-à-vis water and livelihoods related impacts, while majority of the case studies did report on crop related impacts, participation and equity. Figure 8 shows the number of outcome and impact indicator per case study. It shows that almost 75% of the cases had more than 5 indicators.

Figure 7 Number of case studies for which outcome and impact indicators were found (max=108)

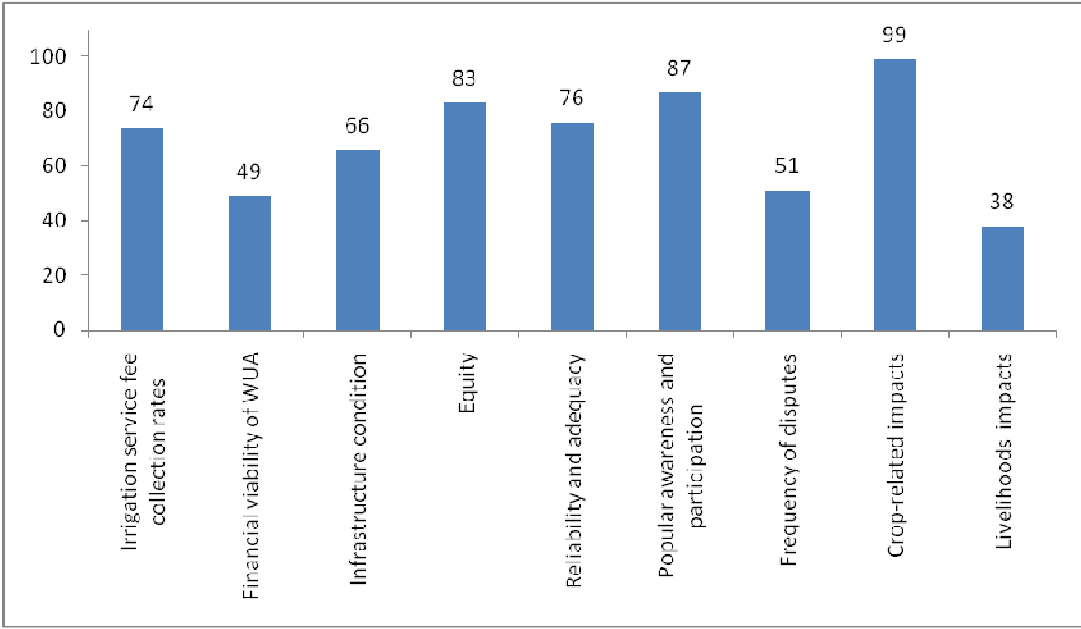
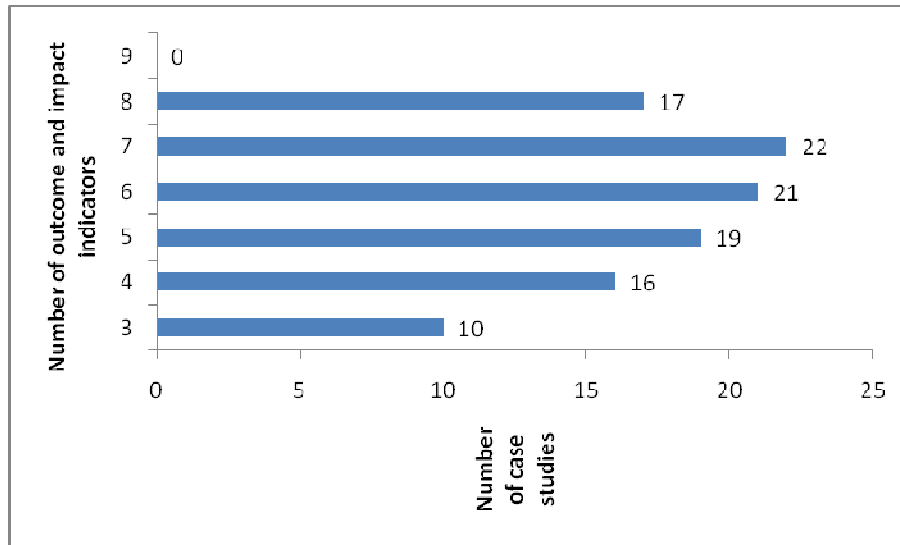


Figure 8 Number of outcome and impact indicators per case study

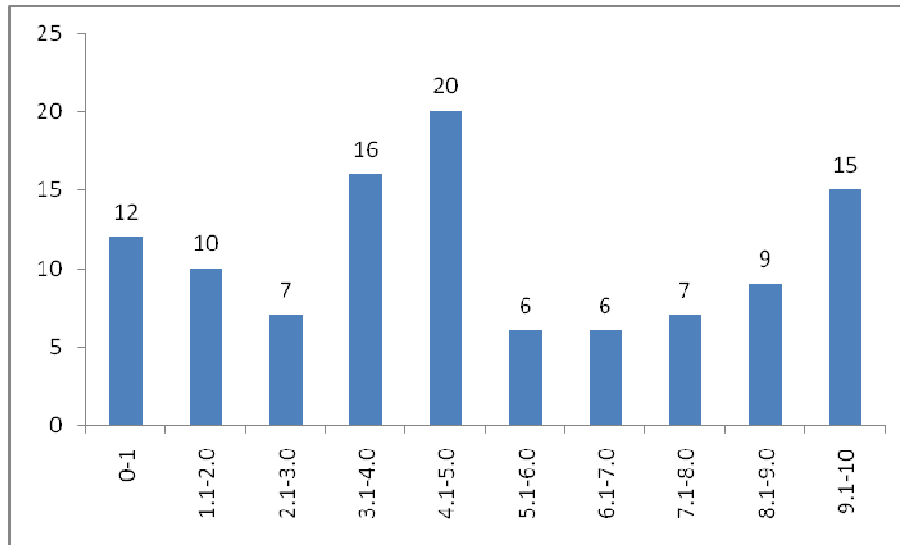


3.3.3 Construction of composite success score (CSS)

The next step was to derive a composite success score (CSS) by which every case study could be scored and ranked on an uniform scale of 0 to 10, where 0 would signify complete failure and 10 outstanding success. The construction of the score was simple enough and involved adding up all the positive scores and dividing it by the maximum possible score. Here, the challenge was to deal with missing values in each of the case studies (as can be seen from Fig. 8, none of the case studies reported all 9 indicators). We decided that whenever data was not available, we will leave it out from our calculation. For example, if outcome and impact indicators were available for 6 out of 9 (maximum) possible indicators, then we will calculate the CSS assuming a maximum possible score of 6 (and not 9). If out of these 6 indicators, three were positive (therefore getting a cumulative score of 3) and 3 were negative or neutral (getting a cumulative score of 0), our CSS would be 3 out of 6 or 0.5 which can be converted to 5 on a 10 point scale (see Appendix 7).

All cases that got a value of 5 and above in our CSS scale were categorized as successful and those with scores of 5 and less were categorized as failure cases. While it may be argued that using a score of 5 as the cut off point is rather arbitrary, we justify our cut off point on the grounds that varying the cut off point between 5 and 6 (when 5.5 is the mean value on a scale of 0 to 5) does not change the over all number of successful and failed cases. However, since our database is publicly available, it is always possible for other researchers to choose their own cut off point and re-do the analysis. According to our cut off point, out of 108, some 65 (or 60%) cases had failed and 43 (or 40%) were successful. Frequency distribution of CSS is shown in figure 9.

Figure 9 Frequency distribution of composite success score



3.3.4 Robustness of CSS

How robust is our scoring method? What are the chances that it may classify a failed case of IMT into a successful one and vice versa? The only way for us to check this was to compare our success scores against the evaluation of the authors. As already mentioned, based on authors opinions, we had coded the case studies as successful, failed and when the authors had stopped short of giving a firm opinion, we had classed those as inconclusive cases. Table 2 compares our success ratings based on CSS, with those of the authors. We find that none of the cases where authors have declared a case to be failure, has turned out to be successful according to our success scores, showing, there is not a single example of a failed case, mistakenly coded as a successful one by us. However, we do find that some 27% of the cases which the authors have declared to be successful, turned out to be failed cases in our scoring system. This is understandable given our way of calculating CSS involves 9 indicators, while the case study authors often declare a case to be successful based on one or few indicators. There were 45 cases where the authors had not given any firm verdict and which we had classified as inconclusive as per the authors. Of these, 64% turned out to be failure according to our CSS, which again is logical. Therefore, prima facie, it seems that our scoring system is more or less robust and chances of misclassification are low.

Table 2 Comparison of author's evaluation of success with our Composite Success Score

Evaluation according to our CSS				
Evaluation according to case study authors	Categories	Successful cases	Failed cases	Total
	Successful cases	27 (73%)	10 (27%)	37 (100%)
	Failed cases	0 (0%)	26 (100%)	26 (100%)
	Inconclusive cases	16 (36%)	29 (64%)	45 (100%)
	Total	43 (40%)	65 (60%)	108 (100%)

4. Critique of case studies

Vermillion (1997) had noted that most of the impact assessment studies of IMT/PIM were flawed in terms of methodology. He and his colleagues at IWMI drew up an outline of a robust methodology and urged other researcher to use it for uniform comparison. The main component of his methodology was combining “before-after” comparisons with “with and without” comparison and gather time series data for at least 3 years before and after transfer in order to understand the impact of the transfer. Later Samad and Vermillion (2000) and other researchers from IWMI (Mukherji and Kishore, 2003) employed

Vermillion’s methodology for assessing impact of IMT/PIM in Sri Lanka and Gujarat, India respectively. However, our reading of 108 case studies shows that such methodological rigor is conspicuous by its absence and much of IMT/PIM studies still relies on “before and after” comparison and worst still, simple descriptions without comparison. In this section, we will systematically review our case studies in terms of their method and rigor of analysis and in doing so look at the following indicators: period after transfer when evaluation takes place, method employed, if or not independent verification of impacts through field measurements was undertaken. But before we do this, we will review the bibliographic information using our bibliographic coding sheet.

4.1 Bibliographic information

We reviewed 70 articles/papers and these yielded 108 case studies. Our case studies were published from 1995 to 2009. Of these 70 articles and papers, as many as 46 were published after the year 2000, showing that 65% of our case studies are of recent origin. Figure 10 shows the year wise distribution of all case studies. Note that eight case studies had more than one source; we used both the sources for coding the characteristics of the case studies, but only the most recent study for coding outcomes and impacts. We sourced our case study from various types of publications (Fig. 11). Most of the case studies were journal articles (32 out of 108) and of these 32 journal articles, 24 were published in ISI ranked journals.

Figure 10 Distribution of case studies across the years, 1995-2009

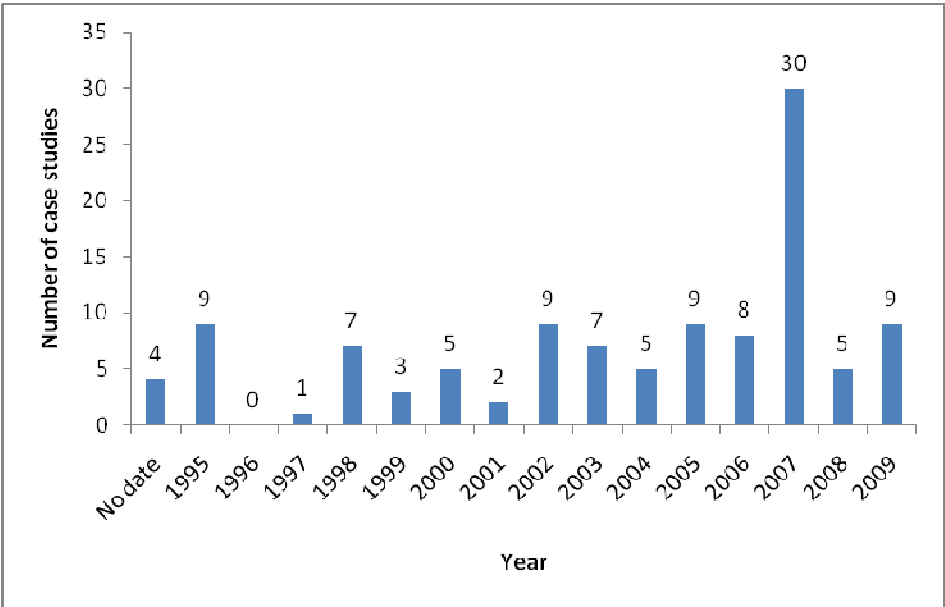
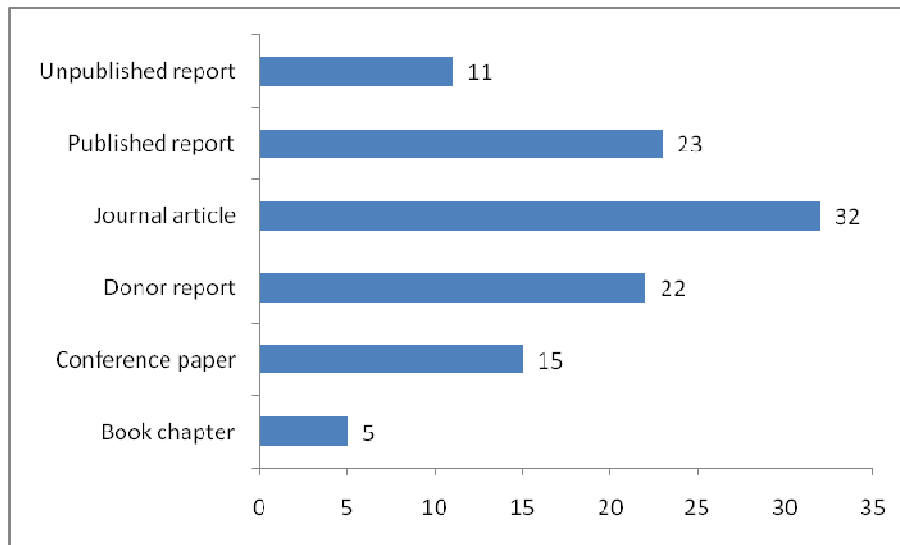
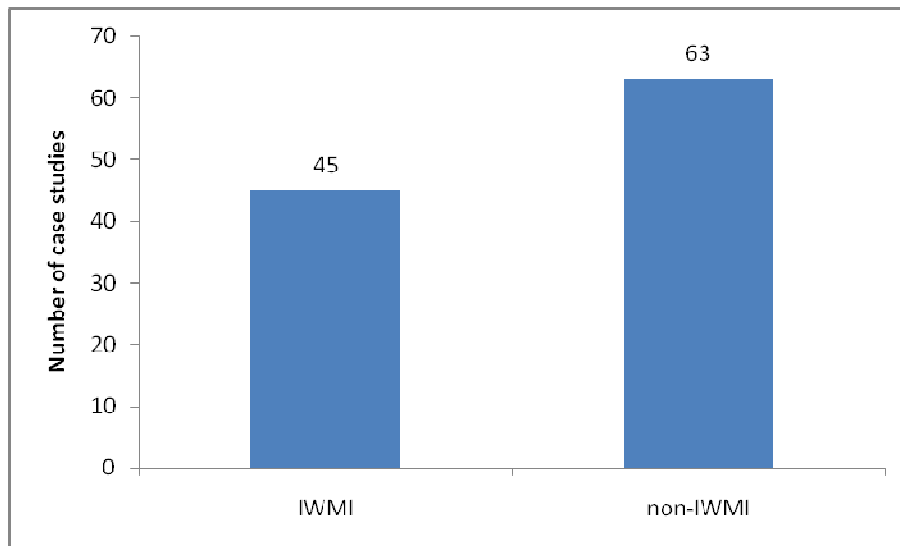


Figure 11 Type of publication from which our case studies have been sourced



IWMI has been a pioneer in the field of IMT/PIM studies and this can be gauged from the fact that a search of global database yielded a large number of studies conducted by IWMI affiliated authors. In our sample of 108 cases, 45 were documented by IWMI authors and the rest by others (Fig. 12).

Figure 12 IWMI vs. non-IWMI case studies



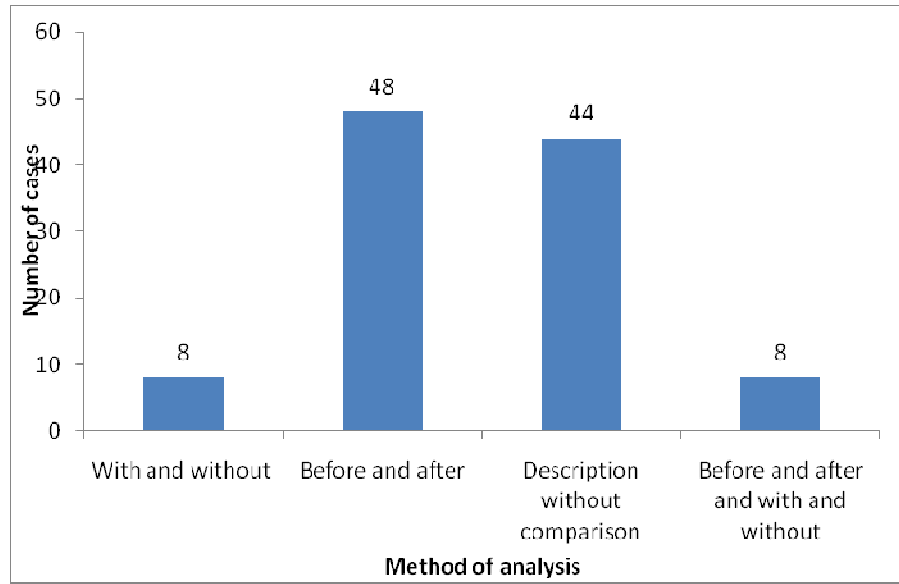
4.2 Critique 1: Method of analysis used

Majority of the studies employed “before and after” analysis, followed by descriptions without comparisons. Only few case studies employed a combination of before-after and with-without analysis (8 cases to be exact). Studies that simply describe the IMT process and its impacts without providing any reference point for comparison are inherently problematic. Before and after comparisons too are flawed because it does not take into consideration factors exogenous to IMT that might have contributed to the success of the schemes. Such is the case with the majority of the case studies. Successes are attributed to IMT and very few cases consider other factors that might have counted for or contributed to the success (or failure) of the scheme. With and without comparisons too may also be flawed because well-performing schemes might be chosen for transfer creating a bias towards success. The best method is a combination of with and without and before and after and that is rarely done. Part of the reason is the difficulty in generating consistent time series data, especially on impact related indicators. Recent developments in

Remote Sensing and GIS offer new possibilities of generating before and after data, especially on crop impact indicators. However, none of our case study authors used RS & GIS for generating crop related time series data.

Therefore, Vermillion's (1997) observation that there is a dearth of rigorous impact assessment studies of IMT/PIM holds as much true in 2009 as it did at the time of his writing in 1997. Figure 13 shows the method of analysis used by the authors of our case studies.

Figure 13 Method of analysis used by case study authors



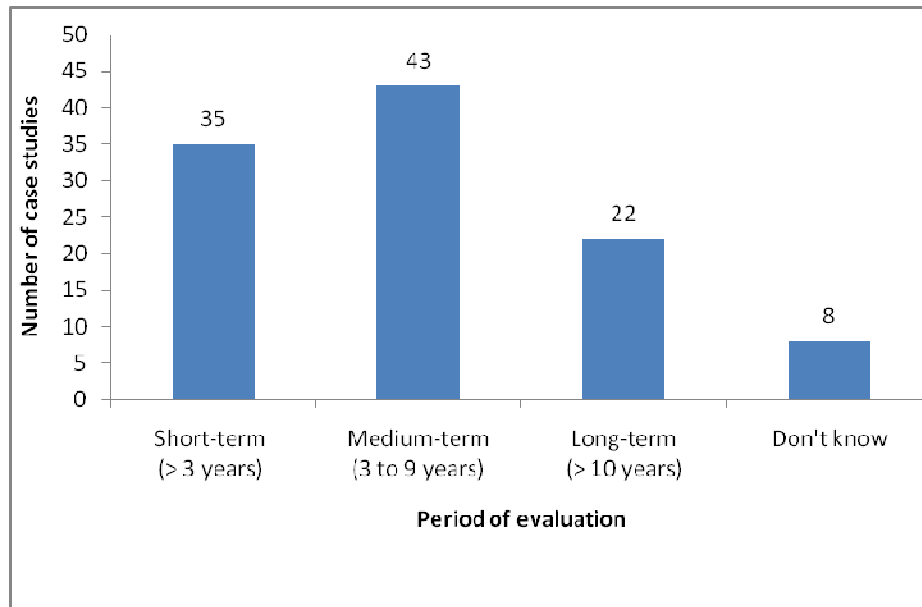
4.3 Critique 2: Lack of independent verification of impacts and outcomes

Another shortcoming of most of these case studies was that they rarely undertook any independent verification of outcomes and impacts. When they did, it was mostly limited to opinion surveys and recall data. Seldom was measurement of crop yields or water discharge and delivery undertaken. Out of 108 case studies, we found that independent verification of impacts (by which we mean on field measurements and reference to data maintained by the WUAs) was undertaken in only 33 cases, while the rest relied on questionnaires and opinion survey, that too, often of only farmer leaders and irrigation officials.

4.4 Critique 3: Dearth of long term impact assessments

Of the 108 case studies, majority are short (less than 3 years) and medium term (3-10 years) studies, meaning that these cases have been evaluated within 10 years of transfer. Only 22 (or 20%) out of 108 cases were long term evaluation studies. This certainly is an improvement from the time Vermillion did his review, showing that long term evaluations are on the rise. Of cause of concern is the large number of very short term assessments (35 out of 108). We contend that 3 years or less is a very short time for evaluating IMT/PIM. Encouraging though is the fact that majority of the case studies are of medium term (43 out of 108) ranging anything from more than 3 years to up o 10 years. Figure 14 shows the case studies distributed in terms of period of evaluation.

Figure 14 Classification of case studies according to period of evaluation



4.5 Critique 4: Lack of consensus on definition of success

What comes out quite clearly from the case studies is that there is a lack of definition of what constitutes success. Often the authors define success based on their own disciplinary leanings. For instance, sociologists and other social scientists would often define success in terms of popular, community participation (see Uphoff, 2000), while water resources scientists would define success in terms of better water control and delivery schedules. However, our review throws up some of the most important indicators of success that have been often used by case study authors (Table 3). It is to be noted that we used most of these indicators in defining success.

Table 3 Some oft cited indicators of success (needs to be updated)

Criteria of success by authors	Number of cases where this criteria was applied
Participative management	36
Managerial capacity of farmer organization	36
Productivity and incomes	33
Equity, adequacy and reliability	33
Decrease in government spending	27
Transparency and accountability	16
Efficient water use	13
Quality of maintenance	7

To sum up, our review of IMT/PIM case studies reveal that majority of these studies are weak in terms of rigor and method. Having said that, these case studies are the only available sources of information on the impact of IMT/PIM in Asia and we use the information contained therein to construct CSS.

5. Evaluation of IMT/PIM cases using composite success scores (CSS)

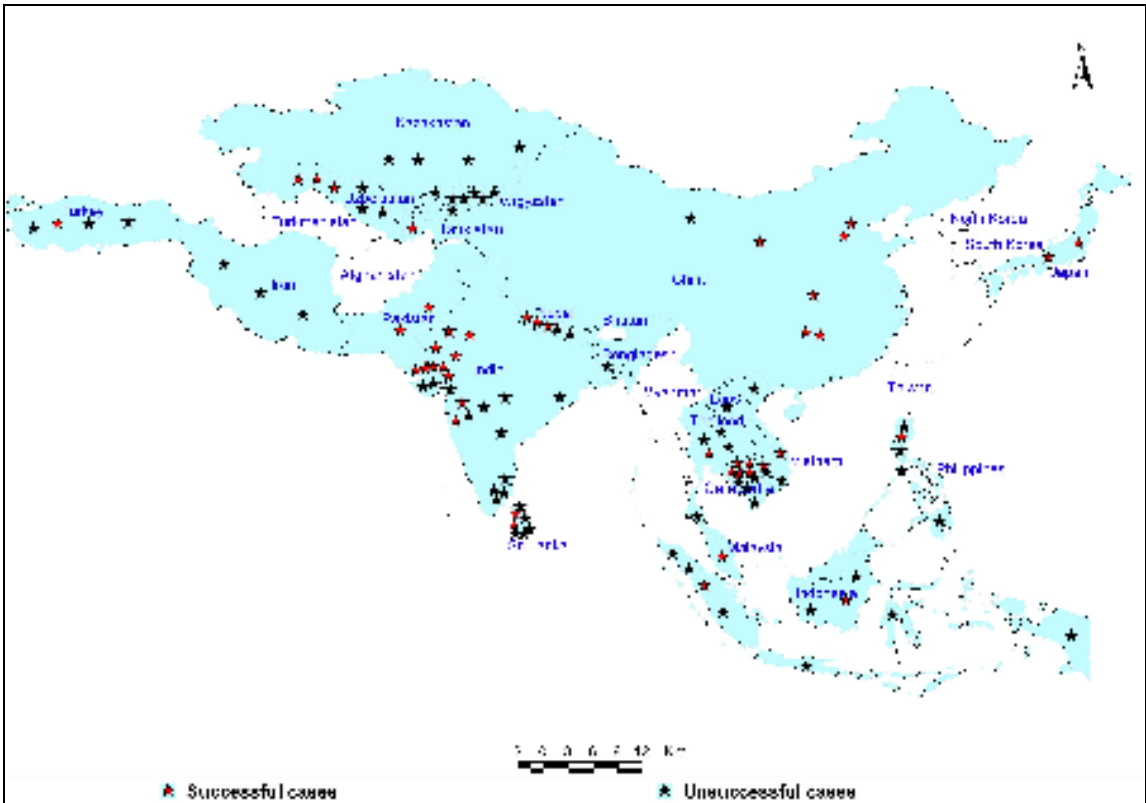
Based on our CSS, 42 of the 108 case studies were evaluated as successful and the rest as failed cases of IMT/PIM. Table 4 and Figure 15 show the country and region wide distribution of failed and successful cases.

Table 4 Composite success score of IMT/PIM intervention in different countries

Country	Success	Failure	Total number of cases
Kazakhstan	0	4	4
Kyrgyzstan	0	7	7
Tajikistan	1	0	1
Uzbekistan	3	3	6
Central Asia	4	14	18
China	5	2	7
Japan	2	0	2
East Asia	7	2	9
Bangladesh	0	1	1
India	11	12	23
Nepal	3	2	5
Pakistan	2	0	2
Sri Lanka	2	5	7
South Asia	18	20	38
Cambodia	6	4	10
Indonesia	2	8	10
Laos	0	1	1
Malaysia	1	0	1
Philippines	1	4	5
Thailand	1	4	5
Vietnam	1	3	4
South east Asia	12	24	36
Iran	0	3	3
Turkey	1	3	4
West Asia	1	6	7
Total	42	66	108

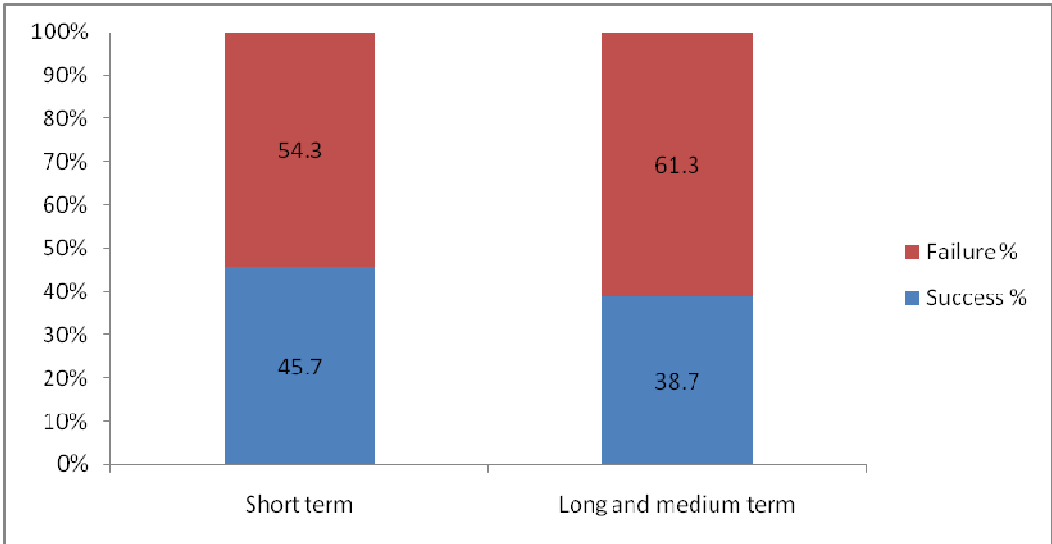
The table shows that rates of success of IMT/PIM are highest in East Asia (China and Japan). Of the 7 cases in China, 5 were successful and both the cases in Japan were successful. As we shall see later in this section, Chinese cases of IMT are not strictly of the PIM type, they are closer to the public-private partnership (PPP) variant of IMT. West Asia, with one successful case out of 7 and Central Asia with 4 successful cases out of 18 were worst performers, followed by Southeast Asia (12 out of 36 cases) and South Asia (18 out of 38 cases).

Figure 15 Distribution of successful and failed cases of IMT/PIM



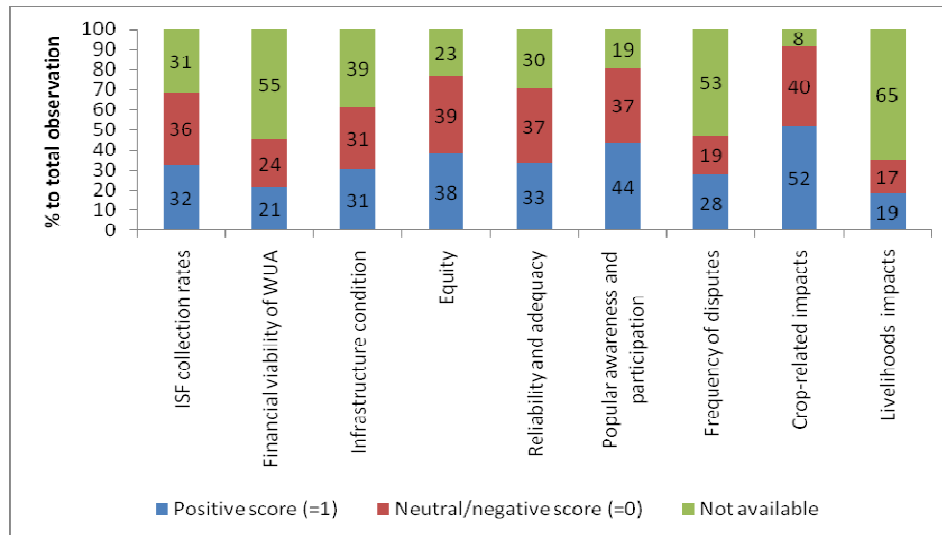
Our case studies varied in terms period of evaluation (that is number of years that had elapsed between the transfer process and the evaluation study) and we categorized the case studies as short term, medium term and long term. It is our view that short term (less than 3 years) evaluations are not useful since 3 years is not enough to understand the outcomes and impacts. Of the successful cases, 38% are of short term and the rest are long and medium term evaluations (Fig. 16).

Figure 16 Success and failure by period of evaluation



As already mentioned, we used 9 indicators for assessing success or failure of IMT/PIM initiative in Asia. Figure 17 shows the performance of our case studies in terms of these indicators.

Figure 17 Performance of case study systems in terms of outcome and impact indicators



We find that in some of the vital indicators, data is missing in more than half the instances (financial viability of WUAs, frequency of water related disputes and livelihoods impacts), while it is missing in 1/3rd of the instances in case of ISF collection rates, physical condition of infrastructure, reliability and adequacy and to a somewhat lesser extent in case of equity in water distribution. The best documented indicators are that of crop related impacts (only 8% of the cases do not provide information on this), followed by popular awareness and participation indicator (19% of cases do not have information on this).

Negative and neutral scores outweigh positive scores in ISF collection rates, financial viability of WUAs, and reliability and adequacy indicator showing that on an average, more number of systems perform same or worse after transfer (or without transfer) than systems which improve on these counts. Positive and negative scores balance each other in case of maintenance of physical infrastructure, equity and livelihoods impacts, showing that these have improved and remained same (or deteriorated) in roughly equal number of case studies. In three out of the 9 indicators, we find that in most cases there has been an improvement after transfer. These are crop related indicators, popular awareness and participation and reduction in conflicts. However, as already mentioned, crop related impacts are tricky because they may not capture the impact of IMT/PIM *per se* and there is evidence to show that they are often more related to rehabilitation than to the transfer process.

To sum up, out of 9 outcome and impact indicators, in case of 3 indicators, negative and neutral scores outweigh positive score, in another 3; they are roughly the same and in rest of the 3, positive scores outweigh negative scores. Having said this, we will now look into how the composite success scores (CSS) is related with individual characteristics of the case studies in the following sections.

5.1 Managing common pool resources

Since the early 1980s, a large number of social scientists including anthropologists, economists, political scientists, human geographers, sociologists and others have contributed to the burgeoning field of common property resources. They found that defying the doomsday prediction of the tragedy of the commons, common pool resource users all around the world often forge institutional arrangements and management regimes that help them use the common pool resources equitably for a long duration of time with negligible equity losses. This observation has led to the next analytical question, that is, under what conditions have such successful institutional arrangement for managing the commons been forged? It is to be noted that much of what we know about the conditions under which common property regimes stems from local commons managed by small user groups and communities.

Based on the work by Wade (1988), Ostrom (1990) and Baland and Platteau (1996), Agrawal (2001) has come up with and added to a comprehensive list of critical factors that ensure sustainable use of the common pool resources or the commons. These enabling or critical conditions may be divided into 4 main categories. These are: (i) resource system characteristics; (ii) group characteristics; (iii) institutional arrangements and (iv) external environment. Further, interaction between (i) and (ii), that is the relationship between resource and resource users' characteristics and interaction between (i) and (iii) that is the relationship between resource characteristics and the institutional arrangements make for the fifth and sixth critical conditions for success of common property regimes. Within each of these broad conditions, there are a number of factors and the presence or absence of each influence the governance of the commons in one way or the other and often these interactions are poorly understood. Table 6 presents critical enabling conditions for sustainability on the commons and is based on Agrawal (2001).

Table 5 Critical factors determining success of common property management regimes

1. Resource system characteristics
(i) Small size
(ii) Well defined boundaries
(iii) Low levels of mobility
(iv) Possibilities of storage of the benefits of the resource
(v) Predictability
2. Group characteristics
(i) Small size
(ii) Clearly defined boundaries
(iii) Shared norms
(iv) Past successful experiences and social capital
(v) Appropriate leadership
(vi) Interdependence among members
(vii) Heterogeneity of endowments, homogeneity of identities and interests
(viii) Low levels of poverty
3. Institutional arrangements
(i) Rule are simple and easy to understand
(ii) Locally devised access and management rules
(iii) Ease in rule enforcement
(iv) Graduated sanctions
(v) Availability of low cost adjudication
(vi) Accountability of managers to the users
4. External environment
(i) Technology: low cost exclusion technology and ease of adoption
(ii) Low levels of interaction with outside markets and gradual change in interaction with outside markets
(iii) State: governments not to undermine local authority, supportive external sanction mechanisms, appropriate external aid if needed and nested governance at different socio-political levels.
5. Relationship between resource and group characteristics
(i) Overlap between resource domain and rights domain
(ii) High dependence on the resource
(iii) Perceived fairness in allocation of benefits
(iv) Low levels of users demand
(v) Gradual change in levels of demand
6. Relationship between resource system and institutional arrangements
(i) Match extractible quantity with its regeneration capacity

Source: Adapted from Agrawal (2001):1659 and based on Wade (1988), Ostrom (1990) and Baland and Platteau (1996).

An important conclusion that can be drawn from the above list of factors is that, there are a large number of factors that encourages or impedes the successful management common property resources. Almost all these factors emerge from case studies of local commons managed by small communities. The set of factors, as can be seen, turns out to be quite large and thus is a potential barrier to formulation of an over-arching theory of the common property resources. Yet, the search for the "magic formula", so to say, continues.

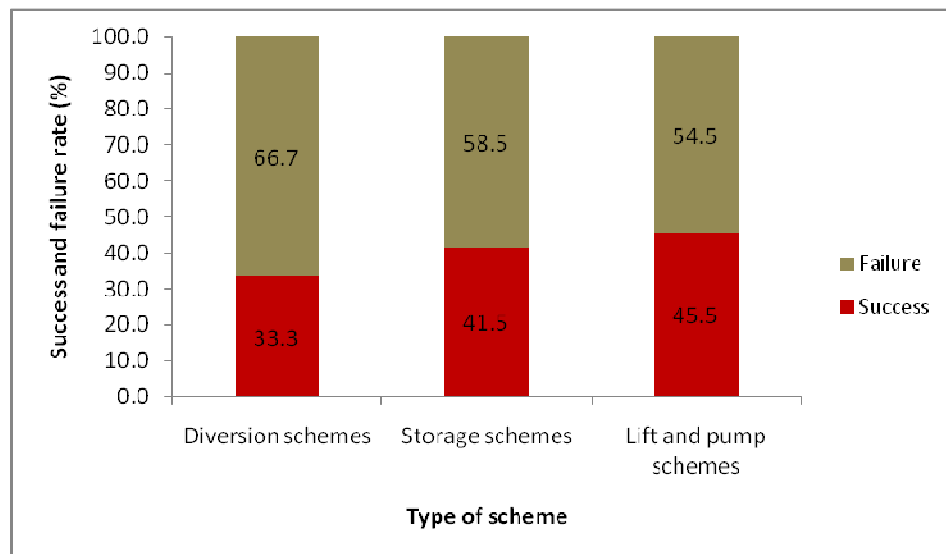
Our rich data based allows us to test some of these hypotheses regarding success and the characteristics of the resources base, of the users and of the institutional mechanisms forged to manage the resource.

5.2 Finding patterns in success

5.2.1 Success by type of irrigation scheme

We divided our irrigation schemes into three types based on the water storage and conveyance technology. These were gravity flow systems with or without storage and lift based schemes. Of the 108 cases, majority (61) was gravity flow storage schemes, followed by gravity flow diversion schemes (18) and pump based lift irrigation schemes (16). Our analysis shows that pump based lift irrigation schemes are more likely to be successfully turned over than gravity flow systems and this difference is statistically significant (Fig. 18). The reason for this may be that, pump based lift irrigation schemes gives users a greater degree of control and are be able to respond to farmers irrigation demand much better than storage or surface diversions schemes. Most of these lift and pump schemes involves pumping of groundwater and farmers, almost everywhere in Asia, inherently value groundwater more than surface water and hence may be more interested in taking over public tubewells for management. A good example is the Gujarat government's tubewell transfer programme which was very successful. In our scheme of coding, it got a high score of 8.6 out of 10. The main reason for success here was the high demand for these tubewells among the farmers and their willingness to take over the management, aided and abetted by easy terms and conditions of transfer by the government. However, tubewell systems by themselves do not guarantee success. An example is the government tubewells in Bangladesh (which got a score of zero in our scheme of coding) where were a complete failure simply because the buried pipe technology of the system was far too complicated for the users. Overall, it can be said that because lift irrigation systems offer better water control, they are often, easier to hand over to farmers for management than gravity flow irrigation systems.

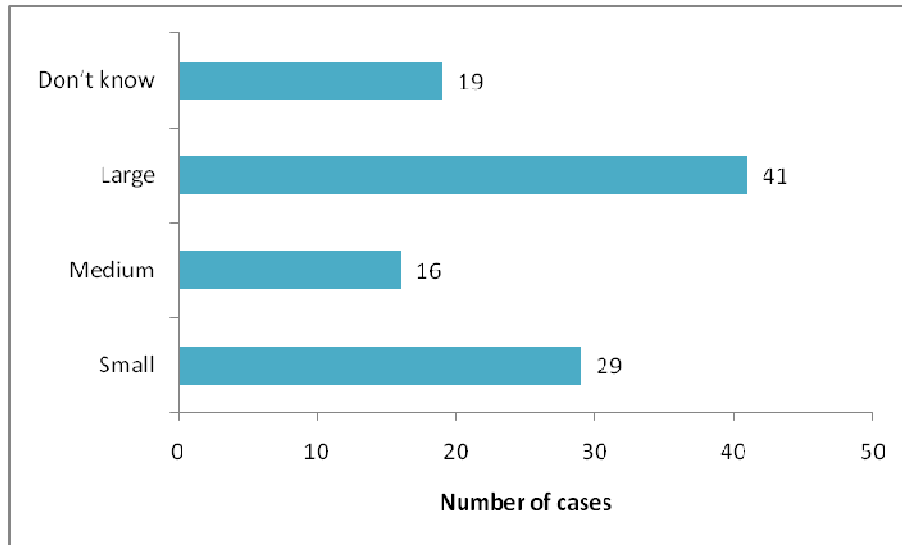
Figure 18 Success and failure by type of irrigation scheme



5.2.2. Success by size of the scheme

In CPR literature, it is often mentioned that size of the resource to be managed is of critical importance in determining the outcomes and that cooperative action is more likely to emerge in small sized resource systems with well defined boundaries. We categorized our case study scheme into three categories depending on the command area of the irrigation project that was actually transferred to the users. These were small scale systems (command area of less than 500 ha), medium scale systems (500-2000 ha) and large scale systems (more than 2000 ha). Figure 19 shows the distribution of our case study system in terms of size (command) area of the system. As can be seen, majority of our case study systems are large scale ones.

Figure 19 Categorization based on the size of the systems



However, in our sample, we donot find much difference in success rates between small, medium and large irrigation systems (Fig. 20) showing that it may not be necessarily easier to turn over smaller systems to farmers. One of the reason for this result may be that even though the size of the actual command area turned over to the farmers may be small, given that, these are mostly large scale public irrigation systems, the overall performance of the much larger public irrigation system affects the management of the turned over parts irrespective of whether or not it is small in size. Here a good example is the case of WUAs in Sardar Sarovar Project which got a dismal score of zero in our coding system. Here even though the command area of the turned over tertiary canals was small, the overall management scenario in the SSP was such that these WUA's stood no chance of success. Systems that serve smaller number of farmers also show higher potential for success (Fig. 21).

Figure 20 Success and failure by size of turned over system

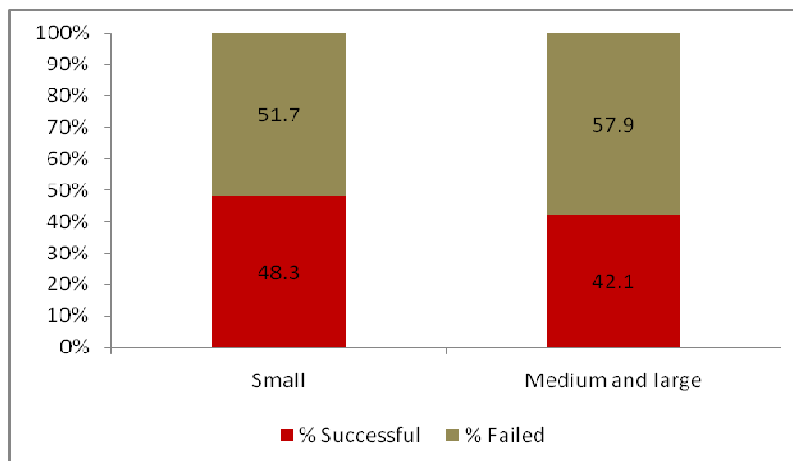
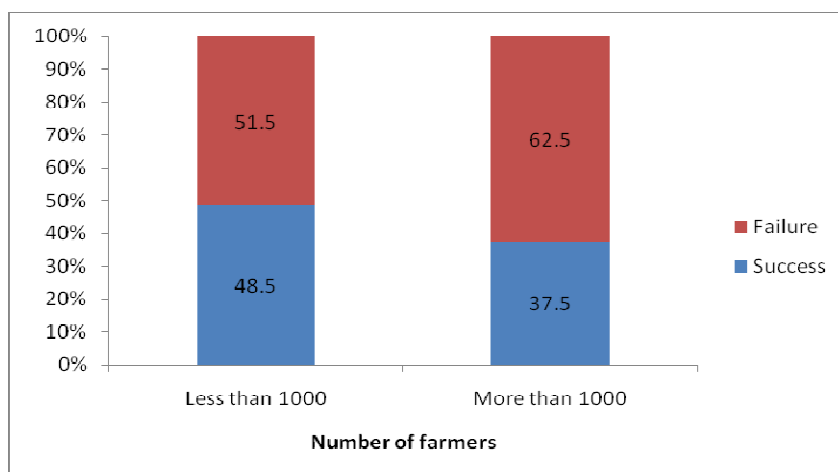


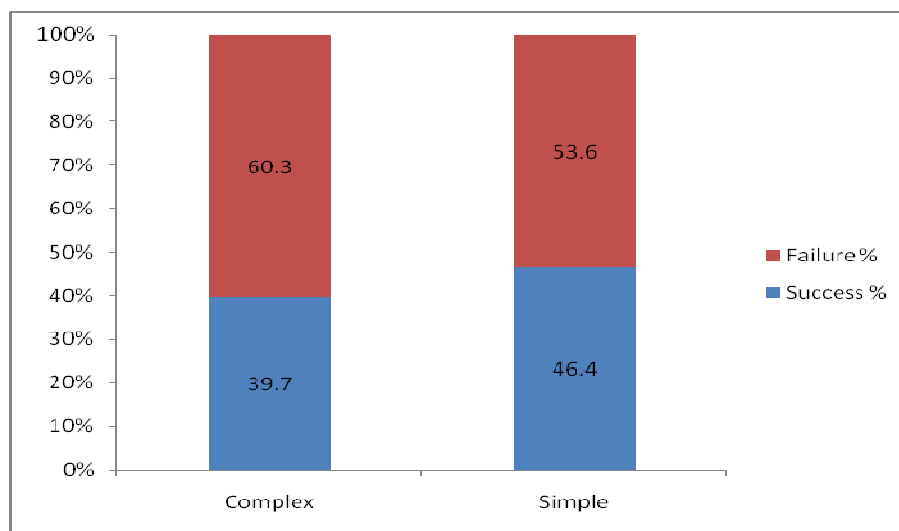
Figure 21 Success and failure by number of farmers served



5.2.3 Success by complexity of the scheme

Schemes were classified as simple and complex using definition of Tang (1992). Quite predictably, most of the schemes were complex schemes (73 out of 108), given that publicly owned irrigation schemes are often built to cater to a large area. It is hypothesized that it is easier to forge cooperative action in simple schemes simply because aspects of water allocation and distribution are simpler needing less amount of planning and coordination. This seems to hold true in our case study schemes. We find that 46% of the irrigation schemes that are simple, are also successful according to our scores, while it is only 40% in case of complex schemes (Fig. 22).

Figure 22. Success and failure by complexity of irrigation scheme

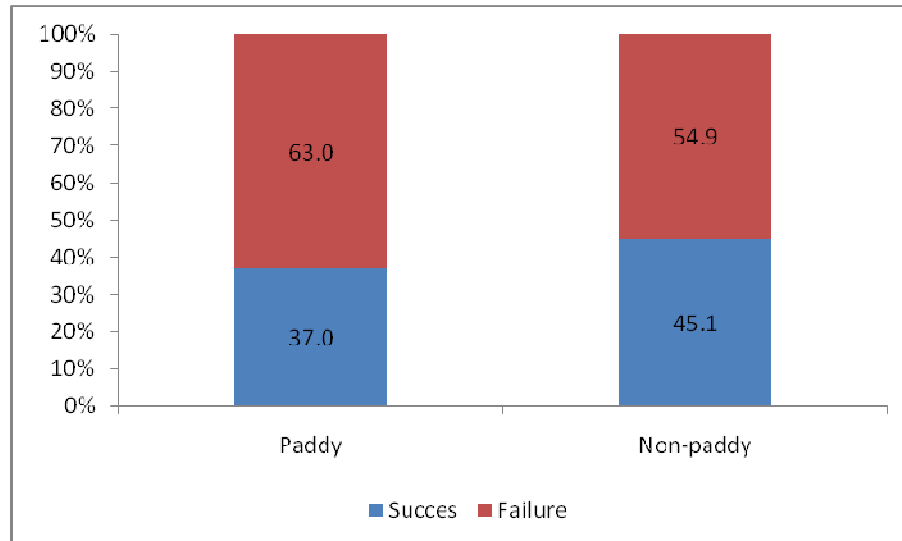


5.2.4 Success by type of crop grown

Tang (1992) found that the type of crop grown in an irrigation system affects the way it is cooperatively managed by the community. The irrigation schemes in our database could be divided into two types based on the major type of crop grown. These were: paddy dominated cropping systems and non-paddy dominated ones. Approximately half of the 108 systems we coded had a paddy dominant cropping pattern and the rest were non-paddy dominant ones. The paddy dominant systems were more likely to fail than the non-paddy dominant ones and this was statistically significant (Fig. 23). Perhaps one of the reasons might be that non-paddy systems needs a certain level of water control, which paddy systems do not. Hence, farmers growing crops other than paddy have better incentive to cooperate. However, it may be

equally well argued that, it is easier to forge cooperative strategy in mono-cropping systems and by this logic, paddy systems have a higher chance of coming up with successful WUAs than non-paddy systems. This argument and counter-argument shows the difficulty in establishing a causal linkage between type of crops grown and the chances of successful WUA.

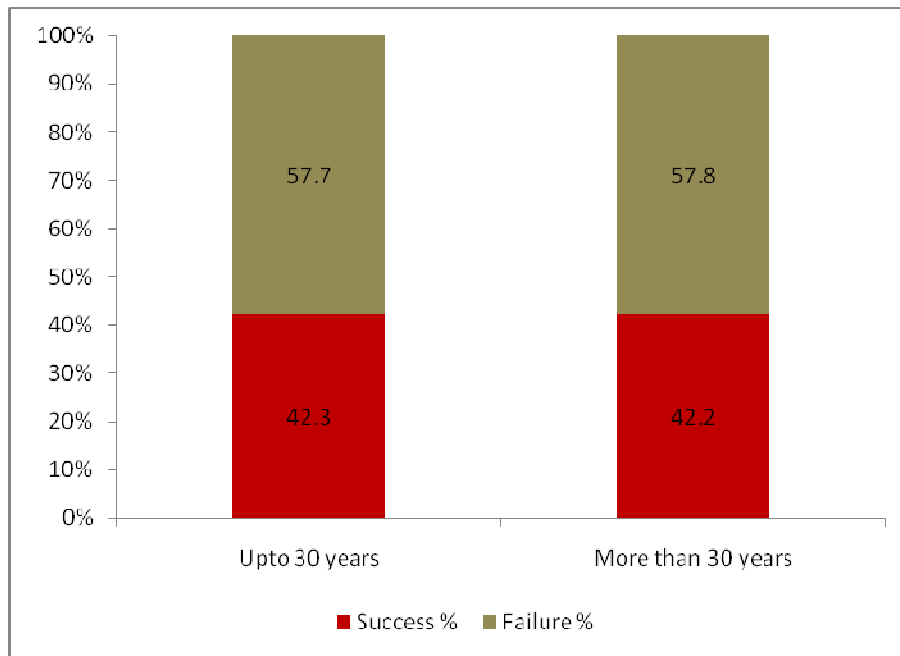
Figure 23. Success and failure by type of crop grown



5.2.5 Success by age of system and rehabilitation before transfer

Does the physical condition of the system (here measured by the proxy variable of age of the system at the time of transfer) affect the performance of the institutions forged to manage the system? It would seem so, as there would be very few takers for dilapidated systems and even if there were takers as a result of government fiat, those organisations are likely to perform very poorly. A case in point are the Central Asian systems, most of which are in poor physical condition after the collapse of the Soviet Republic in 1991. The Central Asian Republics have been following the strategy of forming water users associations and turning over the management of these erstwhile Soviet owned systems to the farmers. Our assessment finds that in majority of the cases, these WUAs have performed poorly (14 out of 18 Central Asian cases were failures as per our criteria). The few that have succeeded have been due to process intensive capacity building by NGOs (and IWMI). Thurman (2001) describes the poor physical condition of the system and how that impedes management by the farmers. In our sample of 108 systems, 26 (or 24%) are less than 30 years old, 45 (or 42% are more than 30 years old) and age is not known for the others. However, we do not find any difference in success rates based on the age of the system (Fig. 24). We believe, the effect of age of the system on the performance after transfer is muted by rehabilitation. Most old systems are rehabilitated before transfer as we shall see.

Figure 24 Success and failure by age of the system

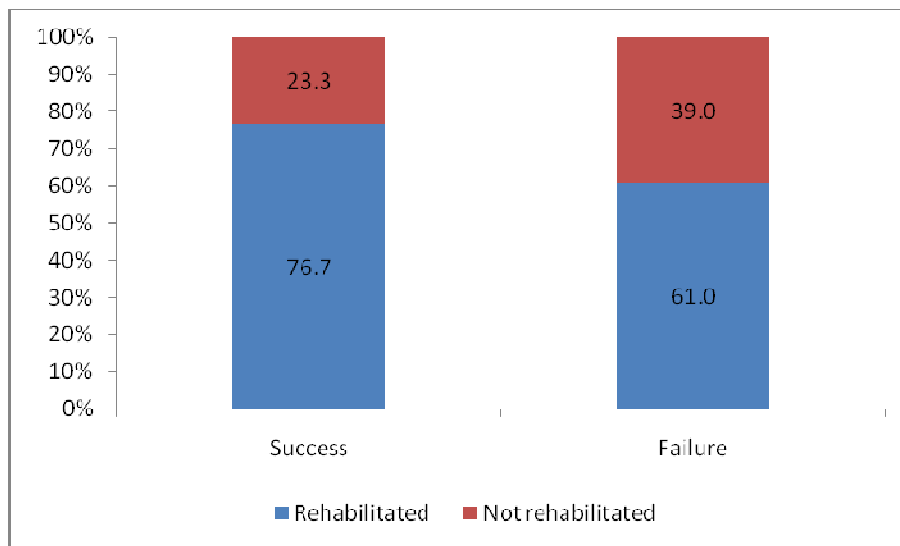


In response, it is often thought that rehabilitating a system before turning it over to farmers for management will help in at least two ways. One, by improving the physical performance of the system, it will make it easier to manage it and second, it will get the farmers interested in managing it. Therefore, rehabilitation of the system often precedes transfer process. Indeed, INPIM and FAO have classified rehabilitation, along with training, formation of WUAs and enabling legislation as four necessary 'inputs' for the transfer process. Very often, it is said, that initial positive results after transfer is more a result of improvement in system performance due to rehabilitation, than due to farmers interest in management per se. Samad and Vermilion (2000) tried to carefully segregate the effect of rehabilitation and transfer by comparing sets of system that were transferred with and without rehabilitation and found that rehabilitated systems performed better after transfer than the systems which were not rehabilitated. In our sample of 108 cases, 48 were rehabilitated before transfer, 23 were not (of these 6 were new schemes and hence did not need rehabilitation) and we do not have information for the rest of the schemes (Fig. 25). It is seen that rehabilitated schemes are more likely to succeed than the non-rehabilitated ones (Fig. 26). However, this by does not itself say if the success will endure the test of time, or whether or not, these rehabilitated systems will be maintained properly later on.

Figure 25 Rehabilitation of system before transfer



Figure 26 Success and failure by rehabilitation



5.2.6 Success by level of management transfer

FAO (2007) defines level of transfer using two criteria. These are: highest hydraulic level transferred (headworks, main/branch canal and distributary canals) and amount of O&M authority transferred (full and partial). We use FAO (2007) definition and categorize our cases studies accordingly.

We find that in majority of the cases, only distributary canals have been transferred and transfer of headworks is very uncommon, unless the scheme itself is very small (Fig. 27). Similarly, in 41 of the cases, full O&M authority has been transferred to the users, while in 46 cases it was a partial transfer of O&M authority and this information was not known in 21 of the cases (Fig. 28).

Figure 27 Highest hydraulic authority transferred

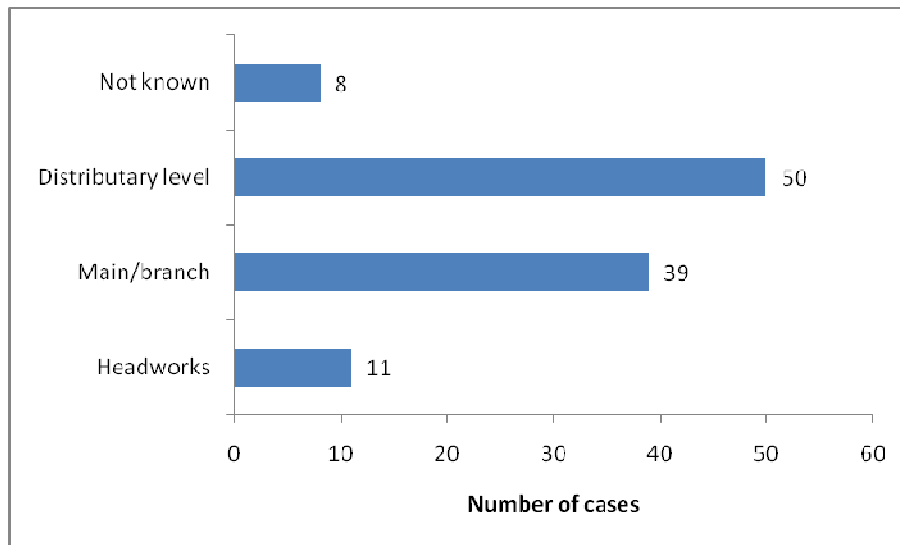
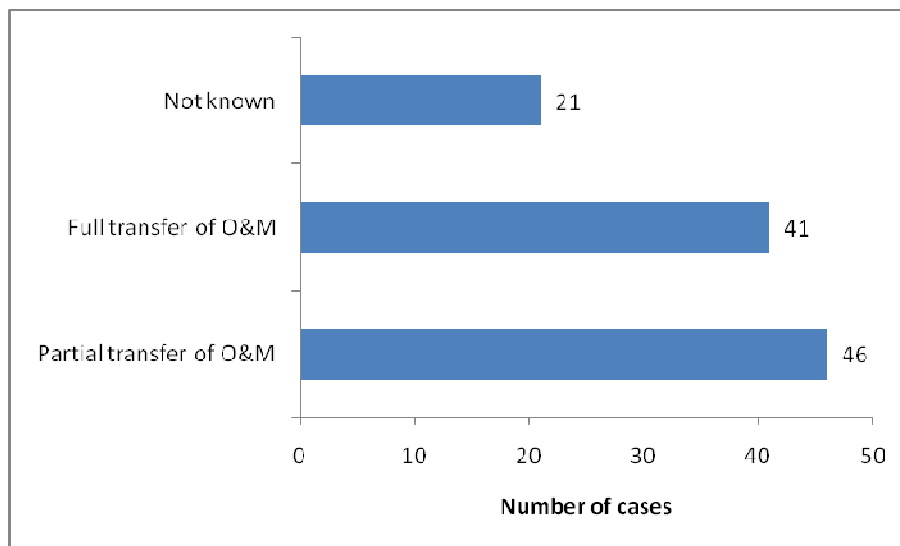


Figure 28 Level of O&M authority transferred to the users



Our data shows that level of management transfer (either at the level of infrastructure) does not have any bearing on the success rates (Fig. 29) but that full O&M transfer is likely to have higher chance of success than partial O&M transfer (Fig. 30).

Figure 29 Success and failure by highest hydraulic unit transferred

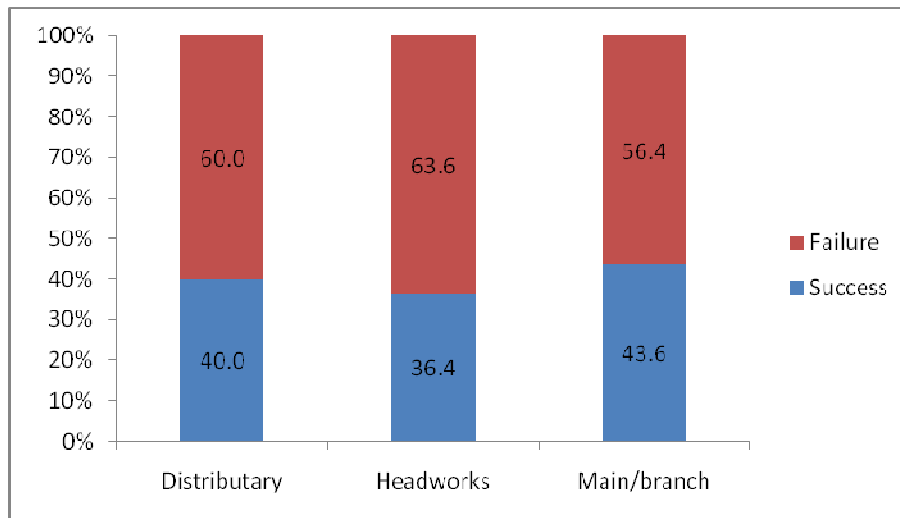
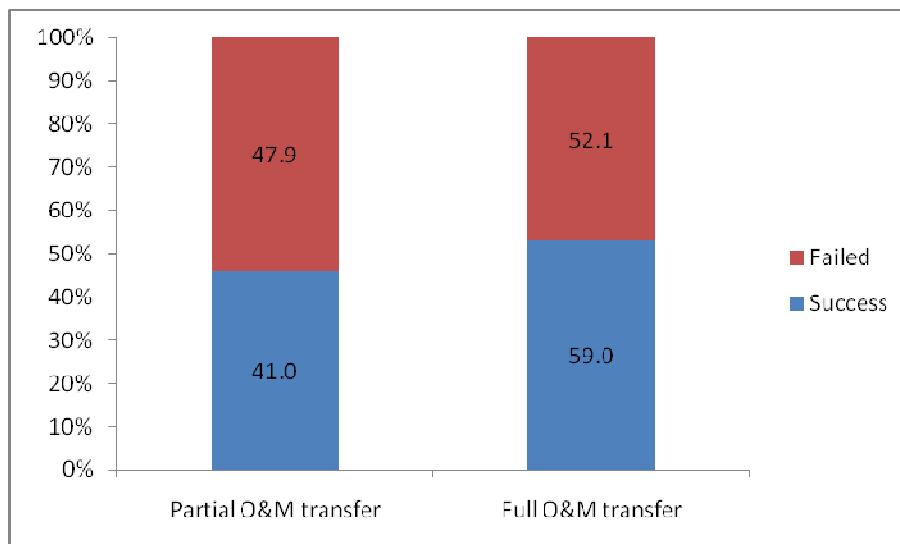


Figure 30 Success and failure by level of O&M authority transferred



5.2.7 Success by training before transfer

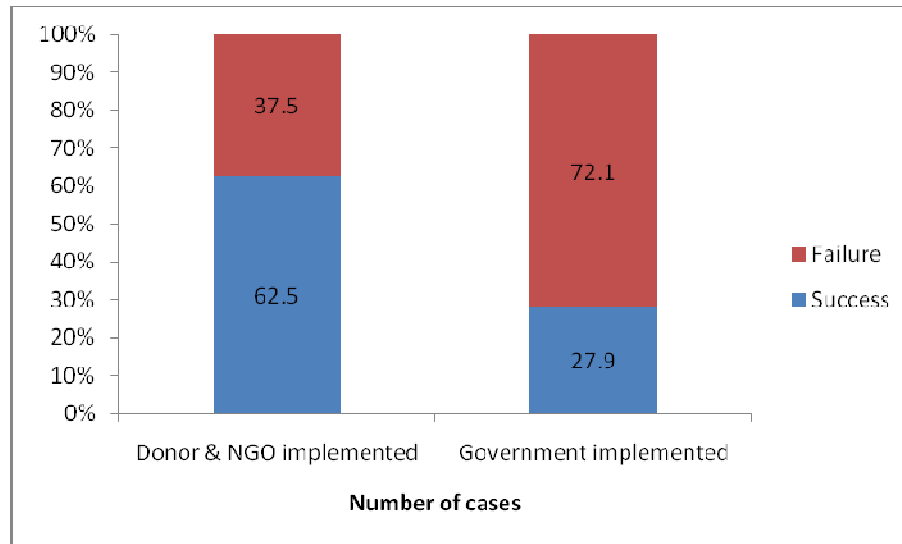
It is often thought that training and capacity building of the farmers before or during the transfer process is of vital importance to ensure success of WUAs. Does imparting training before transfer make any difference? Out of 108 case studies, training was imparted in 56 cases and not so in 3 cases. We do not have information for the others. We found that of the 56 cases where training was imparted, only 20 cases were successful, thereby showing that training may be a necessary, but not a sufficient condition for success. Besides, we found that quality training differs substantially and ranges from 3 day workshops to 3 years of intensive training by a NGO. Hence, it is not so much the fact that training has been conducted, as it is the quality of it, that possibly determines success.

5.2.8 Success by type of implementing agency

IMT/PIM policies in Asia are almost always initiated by government agencies at the behest of donor organisations. Very rarely are they initiated by the farmers themselves, though, we do have a few cases in our sample, where farmers initiated PIM with the support from the government. However, implementation of PIM is more fluid, often done by the NGOs, hired either by the government or the donor agencies. In our sample of 108 cases, we found that government agencies implemented 43 of the cases and donors and NGOs

in 32 cases. Implementor of IMT/PIM in rest of the cases is unknown. We find that chances of success are much higher when NGOs and donor agencies (again possibly through NGOs, though it is not always clear how they implemented it) implement IMT/PIM than when governments do so and it is statistically significant. Indeed, the nature of the implementor, along with the type of crop grown seems to be highly correlated with successful IMT/PIM initiatives than any other factors we examined so far (Fig. 31).

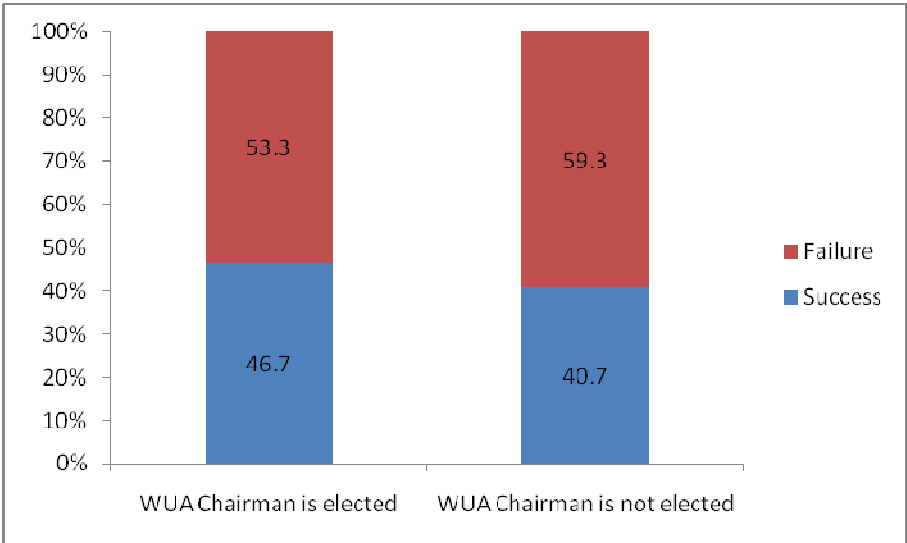
Figure 31 Success by type of implementing agency



5.2.9 Success by representativeness of WUAs

Participation by water users in the activities of WUAs is often considered to be a key factor determining success of WUA. Indeed, participation is thought to be so important that many authors rank participative processes above impact indicators, while evaluating success or failure of IMT/PIM initiative. There are a few indicators that are often used to judge the quality of participation within a WUA. These are: attendance in meetings, number of female participants in such meetings and whether or not the chairman (or the main executive leader) of the WUA is elected by popular votes or not. We use the last indicator to see if WUAs which elect its executive body performs any better than those which do not. There is an obvious gap in our data. Most of the case studies state whether or not the WUA chairman (or secretary) is elected, but it does not say whether or not, these elections were highly contested or they were elected without opposition. Some like Uphoff (2000) are of the opinion that selection of a respected leader as the WUA chairman, rather than election (which according to him brings forward factionalism and petty rivalries) is better for the wider acceptance of WUA. Out of our 108 cases, in 44 cases WUA chairman (or any key decision maker within WUA) was elected, in another 26 cases, they were selected on some criteria or the other and there is no information for the rest. We see that WUA's with elected chairman succeed marginally more than WUA's without elected chairmen (Fig. 32).

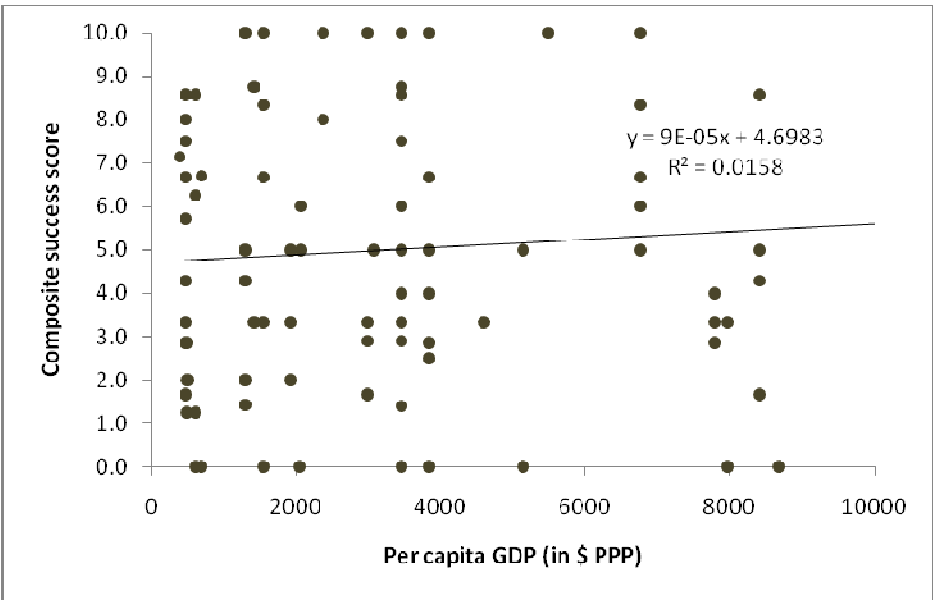
Figure 32 Success and failure by representativeness of WUAs



5.2.10 Success by overall economic condition of the country

Are countries with higher per capita GDP likely to do better in terms of implementation of IMT/PIM than low income countries? High income countries are also associated with lower reliance on agriculture and with higher capacity of the public agency to invest in all sorts of things, including training and capacity building needed for proper implementation of IMT/PIM. They also support dynamic agricultural sectors, where farmers would possibly be willing to pay higher water fees in lieu of better irrigation services. However, in our sample, we do not find any clear correlation between level of GDP (in PPP terms) and performance of WUAs in our sample. Figure 33 shows the relationship between CSS and per capita GDP of the various countries and we find that there is a weak, but positive correlation between CSS and GDP, but it is far too weak to be statistically significant.

Figure 33 Relationship between per capita GDP of countries and CSS



5.2.11 Success and other factors

Whether or not a system is inherently water deficient obviously affects the performance of the system. There is a hypothesis that says relationship between water availability in a system and chances of cooperative action is an inverted U shaped curve meaning that chances of forging cooperative outcomes is less for systems that are highly water scarce or which are adequately endowed with water and is maximum in systems that are neither water scarce nor water abundant. Our case studies do not give much information on water scarcity except in 59 out of 108 cases. Of these, in 43 cases, the authors mention that there is water scarcity at the systems level, while in 15 cases, it is clearly mentioned that there is no dearth of water per se. However, this information is not available for the rest of the case studies. There is not much difference in success rates between systems that are water scarce and that are not water scarce.

Tang (2002) identified social cleavage (meaning whether or not there are steep economic and social inequities within the farming community in the system) as one of the main determinant of cooperative action. We tried to examine this hypothesis, but this particular data is not available in most of the cases and we could deduce this information for 28 out of 108 cases and hence could not use this information for any analysis.

Similarly, importance of irrigated agriculture in the livelihoods of the water users is thought to affect their interest in managing the system, though the causal pathway is difficult to predict. Our case studies offer only fragmentary data for importance of agriculture in the livelihoods of the farmers (58 out of 108 cases) and we do not find any particular relationship between this and chances of success and failure in IMT/PIM initiative.

5.3 Results of logistical regression: What determines success?

In the previous section, we ran one to one correlation of various characteristics of the schemes with success and failure rates. In this section, we will run a logistical regression and see the relative likelihood of each of these individual characteristics of the systems in determining success or failure. The idea is not so much to find causal linkages between success and individual characteristics of the schemes, but to ascertain the conditions which increase the probability of success.

Success or failure of IMT intervention was modelled as binary logistic regression model. It is denoted as follows:

$$\text{SUCCESS} = f_n\{\text{STORAGE, SIZE, CROP, NEWREHAB, IMPLMNT, LVLTR, ELECT}\}$$

where SUCCESS is a dichotomous dependant variable where successful cases of IMT get a score of 1 and failed ones get a score of 0, STORAGE is a dummy variable for type of irrigation infrastructure (storage & lift =1, diversion =0); SIZE is a dummy variable for size of the system (large & medium =1, small=0); CROP a dummy for crops grown (paddy=0, non-paddy=1); NEWREHAB is a dummy for new and rehabilitated systems (1= systems that are less than 30 years old and have been rehabilitated, 0= for all others); IMPLMNT a dummy for type of implementing organisation (1=NGO, donor and farmers, 0= Government); LVLTR a dummy for the level of O&M transfer (1=full, 0=partial) and ELECT is a dummy variable for whether or not WUA key decision maker(s) are elected (=1) or not (=0). Table 7 presents the result of the regression equation. Only 46 out of 108 cases had complete information on all these variables and hence n=46. This is the model with the best fit and it correctly predicts 76.1% of the cases.

Table 6 Logit using observations 2-108 (n=46); Dependent variable: SUCCESS

	coefficient	std. error	t-ratio	slope
Constant	-2.83790	1.63066	-1.740	
STORAGE	0.118054	1.33783	0.08824	0.0292580
SIZE	0.359527	0.757043	0.4749	0.0888251
CROP	1.69093	0.885667	1.909**	0.388653
NEWREHAB	0.233163	0.965311	0.2415	0.0581703
IMPLMNT	2.01105	0.846505	2.376*	0.457774
LVLTR	0.0510247	0.776525	0.06571	0.0126965
ELECT	0.147760	0.783830	0.1885	0.0366978
Mean dependent variable	0.478261	S.D. dependent variable	0.248824	
McFadden R-squared	0.203713	Adjusted R-squared	-0.047533	
Log-likelihood	-25.35479	Akaike criterion	66.70958	
Schwarz criterion	81.33871	Hanna-Quinn	72.18974	
Number of cases correctly predicted = 35 (76.1%)				

The above model shows that when IMT/PIM is implemented by NGO (or through donors and farmers), chances of success are significantly higher than when implemented by government agencies and that systems with non-paddy crops do better in terms of outcomes and impacts of IMT than paddy systems and both these are statistically significant. Storage and lift irrigation systems perform better than surface diversion, while smaller schemes, new and rehabilitated systems, systems where there has been full transfer of O&M and where WUA key decision maker is elected perform better in terms of success than others, but none of these are statistically significant. Thus, the main conclusion from this equation is that chances of success go up significantly when NGO and donors directly implement IMT/PIM programs and when these are implemented in a non-paddy system. The other variables are not significant. As already mentioned, NGO implementation is time and cost intensive and is not easy to upscale.

5.4 Unpacking success and failure: Some qualitative insights

So far, quantitative analysis has shown that there is almost no pattern in successful WUAs that may be replicated across locations. However, this analysis fails to unravel the factors that might have led to successful functioning of some WUA's and complete failure of others. In this section, we use qualitative information from the case studies to critically unpack the factors that led to failure or success in turning over irrigation management to the farmers. For doing so, we look at the cases of outstanding success and complete failures. In our scheme of coding, outstanding success is defined as those that got a score of perfect 10 and complete failures are those that got a score of perfect zero. In our sample of 108 cases, there are 15 cases of outstanding success (CSS=10) and 12 cases of complete failure (CSS=0). We believe that these extreme cases of success and failure will cast some understanding on what leads to success and failure and if, at all, there is a formula out there for success that can be understood and later replicated. Table 8 shows the details of the relevant case studies.

Table 7 Cases of outstanding success and complete failure

Sr. No.	Name of the scheme	Country	Size (ha)	Year of IMT/PIM	Period of evaluation	Composite success score
A. Cases of outstanding success						
1	Toyogawa Irrigation Project	Japan	16,000	n/a	n/a	10.0
2	Bayi Irrigation District	China	5,333	Mid 1980s	Long term	10.0
3	Nanyao Irrigation District	China	2,473	Early 1990s	Long term	10.0
4	Hakra 4-R Distributary Canal	Pakistan	17,600	2000	Short term	10.0
5	Alod Minor, Gudha Medium Irrigation project, Rajasthan	India	251	2000	Short term	10.0
6	Danta Minor, Gudha Medium Irrigation project, Rajasthan	India	536	2000	Short term	10.0
7	LMC Minor No. 1, Gudha Medium Irrigation project, Rajasthan	India	367	2000	Short term	10.0
8	LMC Minor No. 2, Gudha Medium Irrigation project, Rajasthan	India	464	2000	Short term	10.0
9	Panchakanya Irrigation System (PIS)	Nepal	600	1995	Medium term	10.0
10	Baldeva LBMC	India	455	1993	Medium term	10.0
11	Kelara Karalloe, South Sulawesi	Indonesia	7,004	2003	Short term	10.0
12	Kubang Depu	Malaysia	90	1992	Medium term	10.0
13	Moraketiya DC	Sri Lanka	77	1991-94	Short term	10.0
14	Gal Oya Left Bank Farmers Organization	Sri Lanka	16,328	1982	Long term	10.0
15	IWUG SHUAL, Ayuthaya	Thailand	3003	1997	Medium term	10.0
B. Cases of complete failure						
1	WUAs in Sardar Sarovar Project	India	n/a	2003	Short term	0.0
2	Nepal West Gandak Irrigation System	Nepal	8700	1997	Medium term	0.0
3	Ravansar Irrigation System	Iran	2700	2000	Short term	0.0
4	Capayas Irrigation System	Philippines	750	2000	Short term	0.0
5	Tulungagung and Sidoarjo regencies	Indonesia	n/a	1989	Long term	0.0
6	Khlong Thadi Weir System	Thailand	31,552	2004	Short term	0.0
7	Buried pipe irrigation schemes in Tangail	Bangladesh	n/a	1985-1988	Long term	0.0
8	Guimba-Cuyapo Network	Philippines	935	1986	Long term	0.0
9	La Khe Irrigation System	Vietnam	13,000	1997	Short term	0.0
10	Mettupalayam Distributary in Lower Bhavani Project	India	n/a	1987	Medium term	0.0
11	Jai Bajrang Project	India	50	2001	Short term	0.0
12	Kirkkiz	Uzbekistan	n/a	1991	Medium term	0.0

5.4.1 Qualitative analysis of cases of outstanding success

There are 15 cases of highly successful IMT/PIM initiative as can be seen from Table 8. Of these, however, seven cases have been evaluated within less than 3 years after transfer (and 5 within just a year after transfer). We agree with Vermillion (1997) that such a short time period is not enough for evaluating any IMT/PIM initiative and hence we leave them out from this qualitative discussion. We instead concentrate on the eight remaining cases that have been evaluated after three years and some even after 10 years of transfer. It is from these cases of enduring success, we believe, that we can draw lessons. We draw our conclusions from the author's perception on what led to success in each of these cases.

The Toyogawa Irrigation Project is one of the most successful in Japan and according to the authors (Kono et al. 2005), the main reason for success is the participation of the farmers at all levels of decision making and an unique Functional Role Sharing (FRS) model where each organization involved in irrigation water management play their well cut out role without duplication or confusion. Therefore, here the key to success was universal participation and clear demarcation of roles and responsibilities.

The case of Bayi and Nanyao irrigation district of China too is rather unique (Johnson III et al. 1998). Indeed, these two cases fall more towards the public private partnership (PPP) continuum of irrigation management transfer than towards the PIM side in that here the emphasis is on commercial incentives and not so much on participation by the farmers. The key to success here was the introduction of incentives to water resource bureau officials to increase productivity and introduction of diversified and successful sideline enterprises (in Bayi) to pay for and to cross-subsidise irrigation. It is to be noted that in Bayi, farmers have augmented declining surface water supplies with groundwater and purchased water – using funds from sideline enterprises – and have increased output. In contrast, in Nanyao both income and grain output increases have stagnated. Nanyao, with its weak resource base, will probably need to develop additional income sources to be able to improve water management. Bayi and Nanyao epitomize the Chinese model of IMT, which unlike other Asian countries, have eschewed the path of PIM, but achieved desirable results through creating and supporting a clever incentive structure. However, while it is tempting to conclude that finding such incentive structures elsewhere would yield similar results, but chances are high that it will not be so. This is because of the political economy and the nature of the Chinese state. Trying to incentivize irrigation bureaucrats in South Asia will be a difficult proposition in electoral democracies of South Asia, where politicians would be unwilling to offend political constituencies by taking hard decisions.

The Panchyakanya Irrigation scheme (Khanal, 2007) is another example of a highly successful turned over scheme and fits in with many of the conditions of success as documented by Ostrom and her colleagues. It is a small scheme (600 ha), with relatively simple water control structures and free from threat of inundation and flooding unlike most other schemes in the neighboring areas. Farmers have high social capital and they trust their WUA leadership. The WUA was in turn able to craft its institutions in response to new demands and take up new management responsibilities as and when needed and provide continuity in water management.

The success of IWUG SHUAI in Chao Phraya Delta of Thailand (Teamsuwan & Satoh, 2009) is attributed by the authors to its being a pump irrigation project. They posit that as a pump irrigation project, the farmers entail upfront electricity cost, which gives farmers added impetus to organise themselves and manage their irrigation water well – an incentive that is lacking in the other two gravity flow irrigation schemes the authors studied in the same region. Our results also confirm that pump and lift irrigation systems have a higher chance of success and we attribute it to better water control mechanisms.

The final three success cases, namely, Kubang Depu in Malaysia (Kiet & Mat, 2000), Baldeva LBMC in Gujarat, India (Mukherji 2003) and Gal Oya in Sri Lanka (Uphoff, 2000) have one thing in common – all these are pilot IMT/PIM schemes initiated by the government (in case of Malaysian scheme) or NGO (in case of Indian and Sri Lankan scheme) as an exemplary case of IMT/PIM so as to convince farmers elsewhere. The case of Gal Oya is celebrated world wide as a highly successful case of community action, while that of Baldeva LBMC in Gujarat is known all over India as an model IMT case. Both Gal Oya and Baldeva LBMC involved intensive capacity building activities that were carried out by reputed NGO, namely, Agrarian Research and Training Institute (ARTI) of Sri Lanka and Aga Khan Rural Support Programme (AKRSP) in India. ARTI and AKRSP stationed devoted staff in these projects for well over 5 years and these social mobilizers, as they were called, helped train and motivate the farmers so much so that these systems perform well even after the withdrawal of NGOs. However, the process of NGO involvement was long drawn and costly.

To conclude, we find that active farmers' participation (Japan), small size of systems and presence of rich social capital (Nepal), long drawn involvement of NGOs (Sri Lanka and India) and provision of correct incentives to the irrigation official and farmers (China) led to success. The important point here is that all these are hard or costly to replicate, except perhaps the provision of right incentive structure. Therefore, we contend that the Chinese model of IMT might offer the best chances of replication, but this again depends on the larger political economy of the countries in question. Overall, the additional information derived from these highly successful cases strengthens our conclusion that successful cases of IMT/PIM takes place under very context specific and hard to replicate conditions.

5.4.2. Qualitative analysis of cases of complete failure

Out of the 12 cases of complete failures, as we call them, six are short term assessments and hence we do not consider them while drawing lessons. Of the rest six cases, we find that reasons for failure is almost

always the same: unwillingness and lack of preparedness among the irrigation officials and farmers to take over management responsibilities (Ravansar in Iran; Nepal West Gandak irrigation system; Capayas Irrigation system, Philippines), lack of clear cut IMT policies (Philippines, Thailand and Indonesia cases) poor quality of the physical infrastructure (Kirkizz, Uzbekistan), relative insignificance of irrigation in the scheme of things (the case of Kholng Kadi weir system in Thailand) and inappropriate technology and its high cost (e.g. buried pipelines in Bangladesh and high electricity costs in Guimba-Cuyapo Network, Philippines). Indeed, it seems justified to say that all failed cases of IMT failed due to similar reasons, while the successful cases are highly context specific.

This brings us to the next question: can the failed cases be attributed to poor implementation, which perhaps could be fixed through better investments in training and capacity building, or is the problem even more fundamental—at the level of the conceptual design of IMT/PIM? We posit it is the later and hence critically examine the conceptual underpinnings of IMT/PIM discourse in Asia in the next section.

6. Re-examining the conceptual underpinnings of IMT/PIM policy in Asia

In the previous section, we saw that the search for conditions under which successful WUA's emerge did not yield any meaningful results. We found that smaller systems that grow non-paddy crops and where IMT/PIM is implemented with the help of NGOs have a higher chance of success than others and that IMT/PIM initiatives in China are more likely to succeed than anywhere else in Asia. What then are the lessons? How can we replicate success? The answer is that success is so context specific (for example, the nature of the Chinese state) and process intensive (for example, hiring services of a reputed NGO is costly and time consuming) that there is no recipe for success, as it were. We also found that successful cases of IMT are much lesser in number than failed cases. It is important to point out here that our results of 40% successful cases are not representative of the population. This is because, successful cases have a higher chance of documentation in the first place and the way impact indicators are calculated, it is difficult, if not impossible to realistically attribute impacts to IMT/PIM implementation. It is now acknowledged that much of the success noted in short term is due to rehabilitation activities and not IMT/PIM per se.

This leads us to the question: is poor performance of systems after IMT/PIM a problem of poor implementation of IMT/PIM policy or is there a conceptual fault with the entire IMT/PIM paradigm? So far, most researchers were of the view that IMT/PIM is a conceptually sound policy and the problem lies with the implementation part of it. They suggested ways and means of improving the process of implementation (FAO, 2007). However, based on our case studies and readings of history of IMT policy, we claim that IMT/PIM is a conceptually weak formulation and it is not so much of an implementation failure as it is a failure of conceptual idea behind it.

6.1 Shaping of IMT policy: Assumptions versus reality

A review of IMT policy shows that the formulation of IMT policy was driven by three dominant ideas or 'causal arguments' in irrigation. The first idea was rooted in the way deferred maintenance was defined as the major problem in government-managed irrigation systems. Related to the first idea, the second idea was based on the defined 'causal relation' between deferred maintenance and poor system cost recovery. Third, as already mentioned, IMT policy formulation was strongly influenced by the wider acknowledgement of farmers' role in irrigation as documented in farmers-managed irrigation system (FMIS). How justified were these assumptions? We argue that the policy discourse on IMT has stagnated at the level of consensual discourse (Mac Rae, 1993). Consensual policy discourse on IMT is evident from the way its policy assumptions were never questioned or even discussed. The following sub-sections critically review these assumptions.

6.1.1 Deferred maintenance: a donor-driven problem definition?

A wide consensus emerged among national and international policy makers that the problem of government-managed irrigation systems was rooted in poor systems performance caused by rapid deterioration of the physical irrigation infrastructure. Yet, apart from donors' report, this dominant causal argument lacks any conceptual analysis and empirical evidence (Suhardiman, 2008).

IMT policy was formulated primarily as a policy strategy to address international donors' interests and concerns in irrigation sector development in isolation from the actual management situations as experienced by both farmers and the irrigation agency. This is evident from the way the deferred maintenance problem was linked to the issue of cost recovery in relation to international donors' concerns over the physical investments in the sector (Kessides, 1993; O'Mara, 1990). The farmers were more

concerned about the amount of irrigation water channelled to their fields than about the way systems maintenance and rehabilitation were conducted by the irrigation agency. Besides, from the farmers' side there is little motivation to perform regular maintenance (Levine, 1999). Regular maintenance does not significantly increase the actual water flow in the canal, despite the link between maintenance and irrigation systems efficiency. In practice, farmers solve their water scarcity problem either by approaching the irrigation agency staff for additional water supply, or by arranging it illegally, rather than through regular maintenance. Similarly, the irrigation agency was more concerned with the continuous channelling of rehabilitation funds than with the actual impact of rehabilitation (Bruns and Atmanto, 1992; Levine, 1999).

We argue that deferred maintenance is merely a symptom of more chronic problems in the sector's development. In the first place, deferred maintenance is rooted in the problem of bureaucratic rent-seeking within the irrigation agency. Given the emphasis on construction and rehabilitation activities within the irrigation bureaucracy, the agency has little motivation to promote regular maintenance. The irrigation agency's role in preserving the vicious cycle in systems management is highlighted in Wade's studies on irrigation bureaucracy in India (Wade, 1982), and Levine's analysis of the economic rationality of deferred maintenance (Levine, 1999). Levine argues that apart from the agency's interest in preserving the vicious cycle in systems management, deferred maintenance is also used by the agency to mobilize political support for increased funding.

In addition, apart from the physical condition of the irrigation infrastructure, poor systems performance can be caused by many other factors (both social and technical) (Duewel, 1995; Ostrom, Schroeder, and Wynne, 1993). For instance, various studies in irrigation show that actual systems management depends on the farmer-agency relationship as much as on the condition of the physical infrastructure (Huppert and Wolff, 2002; Malano and Hofwegen, 1999). Put differently, the improved condition of the infrastructure will not lead to better systems performance if both farmers' and the agency's role in systems management are not synergized or are in conflict with each other. As long as the actual functioning of irrigation infrastructure remains contested, farmers will continue to reconstruct the infrastructure's formal code of operation, even when this means that they have to damage the infrastructure (Mollinga, 1998). This is what has been precisely happening in India and formal irrigation infrastructure is being reconfigured to meet farmers' requirements (Shah, 2008).

At the level of policy strategy definition, the consensual discourse on IMT policy is evidenced from the way IMT policy discourse was focused on finding the most effective way to transfer systems management from the irrigation agency to WUAs (Johnson III, Svendsen and Gonzales, 2002). For example, Vermillion focuses his analysis on IMT implementation worldwide mainly on how management transfer should be conducted (Samad and Vermillion, 1997; Vermillion and Garces-Restrepo, 1996; Vermillion, 1994). Similarly, policy reports on IMT are focused on identifying conditions for successful IMT. In addition, the World Bank arranged international seminars and workshops on IMT are focused on duplicating IMT implementation worldwide, from successful cases of IMT elsewhere through their so-called 'IMT models' (see Mollinga and Bolding, 2003, for critical review of this model approach).

Nevertheless, the present policy discourse on IMT does not clarify the way management transfer could solve the problem of poor systems performance. For example, the way poor systems performance could be improved through reduced government expenditure on the irrigation sector remains highly speculative. Similarly, it is unclear how the deferred maintenance problem could be solved through farmers' financial contribution. There is indeed not much evidence that IMT would lead to better service fee collection or lead to better maintenance. In our sample of 108 case studies, we found that only in 35 cases, the case study authors mentioned improved service fee collection and they mentioned better maintenance of infrastructure in only 33 out of 108 cases.

6.1.2 Conceptual transformation of FMIS into WUA

With reference to the way international policy makers perceived farmers' involvement as a policy strategy to counteract the deferred maintenance problem, we argue that neither the managerial nor the technical characteristics of government irrigation systems conditioned WUAs to develop the same caliber of farmer organization as FMIS.

The distinct organizational characteristics of WUAs as compared with farmer organizations in FMIS were highlighted by Hunt in his study on the irrigation community (Hunt, 1989). Referring to the organizational dimensions used in his study, FMIS' organizational characteristics are compared with those of WUAs in Table 9.

Table 8 Organizational distinction between FMIS and WUAs

Organizational characteristics	FMIS	WUA
Charter of authority (the source of legitimacy for the authority)	Solid and integrated. Farmers possessed both operational and decision-making authority.	Fragile and fragmented. It is divided between water users and the irrigation agency. While water users are in charge of the operation of the infrastructure, the agency remains the one who holds decision-making authority for system management.
Tasks (i.e. construction, water allocation, maintenance, conflict resolution, and accounting)	<ul style="list-style-type: none"> -Systematically related. Simultaneous responsibility for different tasks is held by a single organization. This organization could consist of different but interrelated sub-units. -Tasks are related to the systems of rights and duties. Conducted work is directly linked to a rewards system. While the central tasks are focused on water allocation, this remains multiply linked with other tasks. 	<ul style="list-style-type: none"> -Inter-organizational coordination became very essential in preventing systemic disintegration as responsibility for different tasks is held by different organizations. Internal relation between the sub-units depends highly on the coordination. -Tasks are mainly related to duties alone, with no rights, no control, and now rewards system. Its tasks are focused on systems maintenance and fee collection.
Role (i.e. leaders, members, workers, users)	<ul style="list-style-type: none"> -Intertwined social links between the different roles. Accountability of each role extends to every member of the systems. -Roles rotate and overlap. 	<ul style="list-style-type: none"> -Divided and yet overlapping social links between those roles belonging to water users and the irrigation agency, which results in a fragile relationship with regard to their accountability. -Roles are distinct and fixed.
Size (line of information and authority)	Short and circular, with multiple communication channels to enable the use of short-cut management route.	Long and parallel. Formal and administrative communication channels predominate. Yet, this does not prevent informal management arrangements to taking place.

Studies conducted by different scholars on WUAs prove that the organizational property possessed by the irrigation community cannot be transferred to the government-managed irrigation system simply through the formation of WUAs (Bromley and Cernea, 1989; Coward, 1986b; Freeman and Lowdermilk, 1985). This is borne out by our case studies too.

The translation of the farmer participation concept under FMIS into government-managed irrigation systems is problematic. In the first place, a WUA's organizational autonomy is challenged by the centralized management in government irrigation systems. Unlike in FMIS, where farmers are in charge of controlling the water source, as well as of arranging the overall water distribution, a WUA's role in government-managed irrigation systems is limited, in most cases, to the tertiary level. Consequently, a WUA's organizational development depends on the management rules defined by the agency, as it relies on the irrigation agency for its water distribution practices. This is all the more apparent where WUAs are created overnight through government fiat, as it was in Andhra Pradesh.

Further, WUAs' involvement in systems management is confronted by the existing management inconsistency in government irrigation systems. Unlike in FMIS, where systems management is arranged and fine tuned between farmers' fields and the water source, WUA have to deal with both farmers' and the agency's diverging perceptions and interests. Also, in contrast to FMIS, where farmers are both water providers and water users, in government irrigation systems the relationship between water provider (the irrigation agency) and water users (farmers) is fragmented and more complex.

Also, the translation of the farmer participation concept under FMIS into government irrigation systems is hindered by a scaling problem (Turrall, 1995). Within the context of a highly technical, large-scale,

government-managed irrigation system, the irrigation system is no longer well bounded in the physical and membership sense of FMIS. Still related to Uphoff's point on the leadership issue (Uphoff, 1981), according to Turrall, a key organizational problem appears here about how to establish greater autonomy and accountability in large-scale irrigation systems with not only more complex technical and operational interdependencies, but also a larger number of farmers. As the number of actors and linkages involved dramatically increases, there is an increased probability of rule breaking and at the same time a decreased probability of detection and sanctioning.

In addition, as government irrigation system has different technical characteristics, it also requires a different type of management. Unlike in FMIS, a WUA's involvement in the overall systems management is bound to a different set of technical requirements. Public irrigation systems are much more complex than FMIS and some of the applied technical combinations of the infrastructure are almost impossible to manage (Horst, 1998, 1994).

Furthermore, in order to cope with the management problem in government irrigation systems, a WUA had to develop other capabilities, specifically financial capability. After all, there is no evidence that the farmer capability that evolved in FMIS would be able to solve the management problems in the government irrigation system. This issue is very much illustrated by intensified fragmentation problem between head-end and tail-end farmers in government irrigation systems. However, the way in which the farmer participation concept is applied in the organizational and institutional approaches implies that, regardless of a farmer's hydraulic position in the system, a WUA should have a uniform function and meaning for both head-end and tail-end farmers. In practice, head-end and tail-end farmers have different ideas on the way the WUA should conduct its water service provision. For instance, head-end farmers prefer loose water control, and thus limited WUA involvement. Tail-end farmers, on the other hand, prefer the WUA to play a greater role in the water delivery service.

6.1.3 Farmers-agency relationship in IMT

International policy makers thought that, with IMT, deferred maintenance problem in the government irrigation system would be solved once the decision-making authority for systems management was transferred from the inefficient irrigation agency to the newly formed WUAs (Vermillion and Sagardoy, 1999; Malano and Hofwegen, 1999; Turrall, 1995). Similarly, international donors and policy makers thought that IMT could redirect the irrigation policies, from infrastructure-oriented to farmers-focused development.

Central to this line of thinking is the way policy makers assume the relationship between the irrigation agency and farmers in IMT to be neutral and apolitical as the irrigation agency is assumed to lack any identity or interests of their own (Suhardiman, 2008). Hence, the thinking goes that new WUAs can be empowered by the very institution these organizations are formed to replace. International policy makers assumed either that the irrigation agency was willing to change its role in the sector development or that it could be ordered and forced to make direct changes in its organizational functioning in accordance with the proposed policy reform, following IMT policy adoption. This assumption was evident from the way international donors and policy makers' prescribed different new roles (such as basin manager, regulator, and policy maker) for the irrigation agency in the post-IMT stage (Johnson III, Svendsen, Gonzales, 2004).

In reality, management transfer has been characterized by power struggles between the irrigation agency as the existing power holder and the WUAs as the designated future decision makers in irrigation systems management. Often, the irrigation agency was not convinced about its new role, or even about the need for management transfer. In extreme cases, the irrigation agency directed the WUA organizational development according to the agency's bureaucratic development path and this resulted in the bureaucratization of WUA (Suhardiman, 2008). WUA bureaucratization was evident from the way WUA staff focused on routine administrative improvements, such as the renewal of WUA staff, the renewal of its basic organizational rules, and proper registration of ISF collection, as well as from the way WUA training was focused on administrative and financial aspects.

The irrigation agency's resistance to change never translated into a revision of the policy concept in IMT. In contrast, research on IMT at that time was focused on finding the key elements for successful implementation, because policy makers believed that the agency's resistance was just one of the barriers to IMT implementation (see the papers presented at the international conference on IMT in Wuhan, China, 1994). The discourse on IMT policy at that time focused on efforts to deal with or remove these

implementation barriers. Even as recently as 2007, FAO recommended that IMT implementation needs political willingness from the government and better legal framework.

Among these barriers were: the lack of coordination between the implementing agencies; the poor organizational performance of these agencies; uncertain fund disbursement for IMT implementation; the WUAs' inability to fill in their new role in systems management; and the irrigation agency's lack of motivation to direct the process of management transfer (Moustafa, 2004; Huppert, Svendsen and Vermillion, 2001). Later, these elements were presented as the preconditions and requirements to be tackled for IMT policy implementation. Proposed remedial actions included: a clear task redefinition between government and farmers; presence of IMT legal back-up; good condition of irrigation infrastructure; and strong support from the government (Frederiksen, 1992). Consequently, research on IMT fell short of explaining the reasons behind the persistent reoccurrence of these implementation barriers, because the irrigation agency's resistance to change was never perceived as possible reason to substantially re-conceptualize IMT policy formulation.

Apart from the farmer-agency relationship, IMT policy makers assumed that farmers were well represented within the WUA and that they were willing and prepared to take over systems management (Bruns, 2003; Vermillion, 1994). In reality, a WUA was often dominated by rural elites (Nikku, 2006; Mollinga, Doraiswamy and Engbersen, 2001). WUAs' functioning was directed towards the representation of the elite's interests, not necessarily related to farmers' needs. Similarly, the way farmers actually perceived this organization or how they viewed the idea of IMT in general remained opaque. Trapped in the assumption that farmers' development needs are incorporated in IMT, existing research on IMT has failed to highlight farmers' actual needs, outside the context of IMT.

6.2 Paradoxes in IMT policy

International policy makers' inaccurate assumptions underlying IMT policy formulation brings into light the conceptual fault in IMT policy. This conceptual fault is manifested in the so-called IMT policy paradoxes. Firstly, the way sectoral reform is initiated by international donors highlights the irrigation agency's paradoxical role in IMT. The irrigation agency is viewed both as government agent, incapable of managing the irrigation system, and as reform agent, responsible for the formulation and implementation of IMT. As incapable government agent, the agency's role is to be replaced by WUAs. Yet, as reform agent, the agency is responsible for the implementation of IMT policy. Paradoxically, IMT is to be implemented not only by the very agency whose power and authority will be reduced by the policy, but by the very agency which was perceived as incapable of managing the irrigation system in the first place. In short, with IMT, it is generally believed that high-performance farmer organizations can be formed and developed by an unreformed, inefficient, and corrupt irrigation agency.

The second paradox in IMT policy formulation concerns how the idea of management transfer was justified as part of the neo-liberal development perspective (Carney and Farrington, 1998) and later also as part of political empowerment, related to the concept of decentralization and democratization (Grindle, 1997). As part of the neo-liberal development perspective, IMT was promoted to increase farmers' financial capability as the direct beneficiaries of irrigation sector development. With reference to the concept of decentralization and democratization, IMT was encouraged to increase farmers' decision-making authority in irrigation systems management. In this context, farmers' willingness to take over the systems management was no longer rooted in how farmers perceived IMT in relation to their development needs. Indeed, evidence from our case studies suggests that farmers were often unwilling to take over management of irrigation systems. Ironically, farmers often did not have a choice about whether or not they were interested in IMT, despite the fact that IMT supposedly promoted increased farmer decision-making authority in irrigation systems management.

Furthermore, international policy makers continued to perceive farmers as a homogenous group, despite the fact that IMT supposedly brought into light farmers' diverse characteristics. The way farmers were continued to be treated as a homogenous group in IMT became evident from the way policy makers labelled farmers as 'water users'. By labelling farmers as water users, IMT does not reveal farmers' actual role in irrigation management. They also do not take into account the distinct differences between head-end and tail-end farmers in IMT policy conceptualization, despite their focus on farmers' role in irrigation.

In reality, nothing can be said about farmers' willingness to take over systems management, or how they perceived IMT, since farmers continue to be treated as development recipients in IMT (see also the concept of labelling by Wood, 1985). International policy makers assumed that farmers' development needs were

incorporated in the IMT program, without taking into account how IMT might be perceived differently by farmers, depending on their location in the irrigation system, their farming practices, their social and economic status, and their access to decision making in WUAs. Data on all these is scarce, if not entirely absent, in all the case studies we reviewed for this paper. Often, international policy makers assumed that farmers were willing to take over irrigation systems management from the irrigation agency, and thus were prepared to act as the agent of reform in irrigation sector development without ever consulting this with farmers prior to IMT policy formulation.

Next, IMT policy paradoxes were apparent from the way its policy concept is trapped in a deadlock of conflicting positions, which manifested in IMT's multi-faceted character. This IMT policy deadlock occurred from the way popular development concepts (such as privatization, democratization, and decentralization) are incorporated into IMT policy conceptualization without being integrated in the first place. The complexity of the irrigation sector and the way international policy makers combine the above concepts seem to merge these concepts into a single yet disjointed policy, in which each claim is incorporated, with their conflicting nature temporarily resolved. Later, this conflicting nature emerges when international policy makers are confronted with combining the basic ideas of the above development concepts into a set of policy strategies.

For instance, in contradiction of the basic idea of democratization, the degree of farmer empowerment in Indonesian IMT was defined primarily through farmers' financial contribution. In Andhra Pradesh, thousands of WUA's were created on paper overnight and then sold to the international community as a big success, only to be exposed for what it was a few years down the line. Similarly, the amalgamation of the ideas of decentralization and privatization confuses the reason behind the proposed management transfer – which was to improve system performance. For many, farmers' participation became the goal, rather the means of IMT, thereby obliterating the basic fact that farmers are interested in receiving adequate and reliable supplies of water in order to increase their production and not interested in participation for the sake of it.

In this context, IMT's multi-faceted character acts merely as a policy disguise. It becomes a policy mask, which can be put on and taken off according to the actual need of each policy occasion. For example, with reference to the issues of democratization and decentralization, the irrigation agency could use IMT implementation to legitimate its commitment towards sectoral reform. With reference to privatization, however, IMT implementation could also be used by the agency to justify its economic interest towards systems cost recovery. Ironically, the irrigation agency used IMT policy as their policy tool and instrument to justify the preservation of infrastructure-oriented development in the sector and secure fund allocation for the sector development (Suhardiman, 2008).

7. IMT as a policy deadlock: What's next?

So far, in this paper, we have argued, using 108 empirical case studies and theoretical understanding from diverse field of studies, that IMT/PIM policy formulated by the governments, at the behest of the donor agencies is fraught with number of inconsistencies and paradoxes. These paradoxes manifests itself through overall poor performance of schemes after transfer and in the difficulty in convincing farmers and irrigation bureaucracy alike about the virtues of managing public irrigation schemes on behalf of the government. Thus, even after 30 years or more of IMT/PIM policy, FAO (2007) review still talks about the lack of commitment on the part of the public agency on the one hand and the necessity of training the farmers on the other hand. We take a different stance on this issue and contend that the incremental approach followed in irrigation reforms so far does not respond to the felt needs of the farmers and hence there is a need for paradigm shift. What are the constituents of such a paradigm shift?

One view is that there is a need to move away from the participation paradigm since farmers are not necessarily interested in cooperative action unless and until the benefits of cooperation exceeds that costs. The farmers, it is said, care about the quality of water delivery service and if we can engage the private sector in irrigation water service delivery and maintenance, then it will be a win-win option for both the farmers and the irrigation agency. This is the Public Private Partnership (PPP) paradigm and is currently preferred by the international donors.

There is another view, propounded by IWMI scientists (Shah 2008), that says that fine tuning IMT/PIM by incorporating PPP principles too is an incremental approach which does not address the basic inconsistency, namely, that socio-technical foundation of Asian irrigation has changed and the public irrigation bureaucracy has been unable to respond to this change. The farmers on the other hand have

responded to the changing socio-technical milieu of irrigation systems in myriad ways and there is a lack of appreciation of farmers' innovations in managing irrigation system among the irrigation bureaucracy and the policy makers. This, we believe, calls for a radical paradigm shift in the way irrigation systems are perceived and managed.

In the following two sections, we will briefly talk about PPP and IWMI's position on irrigation reforms in Asia, with a special focus on South Asia, since much of the lessons were drawn from South Asia.

7.1 Public private partnerships (PPP) in irrigation sector

Conventionally, PPP in irrigation and drainage (I&D) has been defined as the involvement of the private sector (as opposed to farmers in their private capacity) in partnership with the public (irrigation department) to provide different levels of services to the clients. Clients may either be the end user that is the farmer or the public service entity that is the irrigation department. There are four important functional domains of the I&D sector (Prefol et al. 2007). These are:

- a) The investment function including investments in infrastructure
- b) The governance functions of regulation and control
- c) The O&M functions
- d) Agricultural production function

There is a varied scope for investing in the four different functions with the governance function best left to the domain of the public entity and that of agricultural production function left to the private farmers. The other two domains, viz. that of investment in infrastructure and the O&M functions have the best chances of attracting private investments as current evidence shows.

Based on the amount of commercial risk undertaken by the private entity, World Bank (2007) has classified PPP into two categories, namely public contract and public service delegation contract.

However, of late, a consensus has emerged that PPP is not so much about finding an "absolutely private" partner as it is about finding a viable "third party" between farmers and government. This third party may be public (e.g. a reformed or financially autonomous government agency) or private (e.g. a private service provider like a contracting firm, or a WUA turned into a private corporation).

The only extensive review of PPP in I&D sector seems to be the one done by the World Bank in 2007. They have documented 21 cases of PPP in the sector, of which 7 are in MENA region, 5 are in Africa, 4 are in Europe, 2 each in Asia and Latin America, 2 in Europe and only one in Australia. The geographical spread of the PPP interventions is revealing: it shows that donor supported PPP has taken off in poorer African countries while the developed countries which have robust institutions and legal framework in place have more or less steered clear of the PPP path in I&D sector, possibly out of concern of the stronger farming lobbies.

The World Bank paper however does not throw any light upon this aspect of PPP, though it does conclude that PPP results in better water service at a higher cost induced by decreased government subsidies. Therefore the question here is that in Africa, where cost of crop production and inputs is already very high (example, a 100 kilo bag of urea costs USD 60 in Ethiopia as compared to USD 10 in India and USD 7 in Sri Lanka), will PPP help? While this is somewhat outside the scope of this review as it focuses on Asia, it is a question well worth asking and finding answers for.

Some of the other important findings of the study were:

1. Except two cases, PPP was a recent business and hence it was too early to take a call on success or failure of the interventions.
2. In almost all cases, PPP was initiated by the public authority (whether or not at the behest of the donor is not mentioned) and therefore it was concluded that private sector is yet to take proactive interest in investing in I&D sector, unlike other sectors such as WSS and roads and infrastructure sector.
3. Most of the PPP involvement was in O&M (90% of cases) and investment in infrastructure (50%).
4. Majority of the contracts were PSD contracts which meant that payment to the private entity was tied to the quality of the service provision to the end users. This exposed the PSD service provider to increased commercial risks.

5. Finally, as mentioned before, apart of some evidence that quality of service improved along with the cost of provision of the service, there was no evidence on the impact of PPP arrangements on the crop production practices of the farmers, including whether or not farmers could cope with the increased costs of irrigation and risk of growing higher value crops. This is a major lacuna in the study.

7.1.1 Examples of PPP in Irrigation and Drainage Sector in Asia

The World Bank (2007) study listed only two case studies from Asia. One was from the Tienshan Irrigation District in China where a PSD contracts for O&M of dam and main canals was given to strong and autonomous Water Supply Corporation (WSC) and branch and lateral canals were transferred to strong WUAs. This is a case of unbundling of irrigation services much like unbundling of power sector where generation, transmission and distribution functions are given to separate entities. Another example quoted by the World Bank study was that of a World Bank supported scheme of transferring public tubewells to private entities in eastern Uttar Pradesh in India.

We found 8 more cases of PPP in Asia where PPP is defined as the involvement of a viable “third party” between the farmers and the governments. Table 10 lists all the 10 cases of PPP in Asia (including examples from the World Bank Study). Note that many of these are also part of our larger sample of 108 case studies (e.g. public tubewells in Gujarat, irrigation contractors in China etc.)

Table 9 Examples of PPP in I&D sector in Asia

Sr. No.	Type of PPP	Name and location	Project details	Impact, if known	Source
1.	Canal contracting	Various IDs in Ningxia and Henan province, China	Study conducted in 51 villages with and without canal contracting	Villages with canal contracting performed better and “saved” 40% more water than WUA villages. Also number of contracting villages have gone up from 5% in 1993 to 13% in 2005.	Wang et al. 2002
2.	Canal contracting	Jinghuiqu irrigation bureau in China	Of the 538 canals, 428 operated under the contracting system by 2000.	Water fees collection seems to have gone up as the managers in charge of collecting water fees gets incentive payments. Mixed evidence on increase in yields, but water savings seems to be on the rise.	Lioa et al. 2008
3.	PSD contract and unbundling of service provision	Tieshan Irrigation District, Hunan, China	Hunan local government handed over responsibilities to strong and autonomous water service corporations (WSCs)	Better maintenance, less conflict and real WSC control of asset maintenance funds	World Bank 2007
4.	Irrigation bureaucracy converted to entrepreneurs	Water Conservancy Bureau, Hebei, China	WCB in Hebei Province raised a substantial amount of money (from sideline enterprises, which was reinvested in irrigation, in construction and rehabilitation in particular.	These sideline enterprises generated profits, and also created employment and served to absorb redundant irrigation department staff. In Bayi, of the 67 employees in the irrigation district, 30 worked in water management while 37 were involved in the management of such enterprises.	Johnson III et al. 1998
5.	Lease contract to farmers companies	Lease of public tube wells to farmers companies and cooperatives in Gujarat, India	Transfer of tubewells to farmers companies under lease contract ranging from 1 year to 5 years	Turned over tubewells performed better than tubewells still with the government and performance of the turned over tubewells improved after turnover.	Mukherji and Kishore, 2003
6.	Privatization and or involving private operators	Privatization of public tubewells in Eastern Uttar Pradesh	This involved private operators in management of the public tubewells.	The World Bank Report says that the result was that it obtained access to underground water for 800, 000 poor farmers. However, later assessments were less encouraging.	World Bank, 2007
7.	Privatization and disinvestment	Bangladesh	Sale of publicly owned minor irrigation equipment deep tubewells and LLP) to private entities in Bangladesh and limited companies	Mixed results, most of the deep tubewells were much too complicated for individual farmers to operate.	IIMI 1993
8.	Privatization and disinvestment	Dismantling and disinvestment of SCARP tubewells in Pakistan Punjab	Some 13500 SCARP tubewells handed over to Farmer’s Organizations.	Apparently there is a high amount of enthusiasm to famers to take over these smaller tubewells and by early 2000s some 1500 farmers’ organizations were formed.	INPIM newsletter 2004
9.	Ownership and transfer of assets contract by a farmer’s company	Ridi Bendi Oya Farmers Company in Sri Lanka	A public limited liability company owned by farmers under the provisions of the Companies Act of 1982 was piloted in Ridi Bendi Oya scheme in Sri Lanka in 1998.	Later studies have shown that success of this company has been mixed and its performance declined sharply after the withdrawal of the funding agency	Personal communication with Namika Raby
10.	PPP in institutional capacity building of the WUAs	Andhi Khola system in Nepal	The Butwal Power Company agreed to provide Rs. 250000.00 per annum to the WUA of Andhi Khola for organizational and institutional development	Results seem to be positive, but this reports a somewhat old study of 1997, so it needs to be updated.	Aryal and Rajouria 2007

7.1.2. Lessons from Asian cases of PPP in I&D sector

We found that PPP or at least extended version of the PPP is more common in Asia than is generally thought. Our understanding is that there are many more cases of innovative involvement of the private sector or a “third party” than is documented in literature. Therefore an exploratory and field based study on the prevalence of PPP in Asian I&D sector will be timely and appropriate given the high interest among the donors and sometimes even national governments in engaging private sectors in management of irrigation projects.

We also found that almost all the cases of PPP are either of recent origin and hence it is preliminary to draw conclusions from them and when they have been in operation for a while, there is a lack of robust impact assessment studies.

In general it seems that PPP has succeeded where at least one or more of the following conditions prevail:

1. It is possible to exclude potential users given the nature of the technology (e.g. gravity flow systems vs. lift irrigation systems). This is a reason why turning over of government tubewells to private entrepreneurs has been easier in all of South Asia than engaging private operators in managing canals.
2. There exists a strong political will and ability to enforce that will (as in China). It is from China that most cases of successful PPP have emerged. Here state is relatively strong with its presence felt right into the country side. In South Asia, there is a huge mismatch between the state’s ambition and capabilities in enforcing state directives and the civil society and private entities are often as strong as the state.
3. Farming is a profitable enterprise where every drop contributes to higher marginal returns (commercial and diversified farming systems vs. subsistence cereal based system). For example, most cases of PPP within India comes from the state of Gujarat, where in response to physical water scarcity, farmers have diversified their cropping systems by moving away from cereal crops to high value crops that gives them higher return for every drop of water. It is here where dollars per drop of water is high that PPP finds its best niche.

Ironically, these are also some of the conditions under which conventional IMT/PIM is likely to succeed. Therefore, if the intention of implementing PPP is to glean success from cases/regions where IMT/PIM have failed, then there is need for serious re-thinking of the paradigm. Based on a preliminary reading of both IMT/PIM and PPP literature, it seems that systems where subsistence and cereal based cropping still dominate, neither IMT/PIM nor PPP can result in better service delivery. In these cases, more, rather than less government involvement will be necessary, while PPP solutions can be targeted at regions with more dynamic agrarian sector. We shall come back to this point at the end of this paper.

7.2 Reform or morph: Responding to the changing socio-technical foundations of Asian irrigation

Our review of PPP in I&D sector leads us to conclude that PPP is but a variant of IMT/PIM model and its chances of success are no different from the conventional IMT/PIM model in vogue in much of Asia. However, we contend that in order to forge effective models for managing irrigation, it is important to understand the socio-technical context within which irrigation operates. Table 11 summarizes a broad-brush selection of socio-technical conditions that prevailed during pre-colonial, colonial and post-colonial eras in many Asian countries in general and South Asia in particular.

Table 10 Socio-technical context of surface irrigation in different eras

	Pre-Colonial (Adaptive Irrigation)	Colonial (Constructive Imperialism)	Post-Colonial (Atomistic Irrigation)
Unit of irrigation organization	Irrigation Community	Centrally managed irrigation system	Individual farmer
Nature of the state	Strong local authority; state and people lived off the land; forced labor; maximizing land revenue chief motive for irrigation investments	Strong local authority; land taxes key source of state income; forced labor; maximizing land revenue and export to home-markets chief motive for irrigation investments; state used irrigation for exportable crops	Weak state and weaker local authority; land taxes insignificant; poverty reduction, food security and donor funding key motive for irrigation investments; forced labor impossible; electoral politics interfere with orderly management
Nature of Agrarian society	No private property in land. Subsistence farming, high taxes and poor access to capital and market key constraints to growth; escape from farming difficult; most command area farmers grow rice.	No property rights in land. Subsistence farming and high taxes; access to capital and market key constraints to growth; escape from farming difficult; tenurial insecurity; most command area farmers grow uniform crops, majorly rice.	Ownership or secure land use rights for farmers; subsistence plus high value crops for markets; growing opportunities for off-farm livelihoods; intensive diversification of land use; command areas witness a wide variety of crops grown, with different irrigation scheduling requirements
Demographics	abundant land going abegging for cultivation; irrigable land used by feudal lords to attract tenants	abundant land going abegging for cultivation; irrigable land used by feudal lords to attract tenants	Population explosion after 1950 and slow pace of industrialization promoted ghettoization of agriculture in South and South-east Asia and China.
State of irrigation technology	Lifting of water as well as its transport highly labor intensive and costly;	Lifting of water as well as its transport highly labor intensive and costly;	Small mechanical pumps, cheap boring rigs, and low cost rubber/PVC pipes drastically reduce cost and difficulty of lifting and transporting water from surface and groundwater.

The hypothesis is that particular forms of irrigation organization we find in these eras were in sync with the socio-technical fundamentals of those times. Irrigation communities thrived during pre-colonial times when: [a] there was no alternative to sustained collective action in developing irrigation; [b] strong local authority structures, such as *Zamindars* (landlords) in Mughal India, promoted—even coerced—collective action to enhance land revenue through irrigation; [c] exit from farming was difficult.

Similarly, large-scale irrigation systems during colonial times kept anarchy (for example water theft and vandalism), atrophy (denoted by poor condition of the physical infrastructure) and noise (defined as the gap between the service a system is capable of delivering and the service irrigators demand at a point in time) in check because: [a] land revenue was the chief source of government income, and enhancing it was the chief motive behind irrigation investments; [b] state had a deep agrarian presence and used its authority to extract ‘irrigation surplus’ and impose discipline in irrigation commands; [c] farmer had practical alternatives neither to subsistence farming livelihoods nor to gravity flow irrigation. These socio-technical conditions created an ‘institutional lock-in’ that ensured that public irrigation systems performed in terms of criteria relevant to their managers at those times.

Post-colonial Asian societies are confronted with a wholly new array of socio-technical conditions in which neither irrigation communities nor disciplined command areas are able to thrive. The welfare state’s revenue interests in agriculture are minimal; the prime motive for irrigation investments is food security and poverty reduction, and not maximizing government income. Governments have neither the presence and authority nor the will to even collect minimal irrigation fees needed to maintain systems. Then, agrarian economies are in the throes of massive change. Farmers can—and do—exit agriculture with

greater ease than ever before. Growing population pressure has made small-holder farming unviable except when they can intensify land use and diversify to high-value crops for a growing urban and export markets. Finally, gravity flow irrigation systems are hit by the mass-availability of small pumps, pipes and boring technologies that have made 'irrigation community' redundant; these have also made the irrigator impervious to the anarchy, atrophy and noise in surface systems, and therefore reduced her stake in their performance.

In the midst of these changing socio-technical fundamentals, Asia's surface irrigation enterprise is up against some hard questions. Everywhere, PIM/IMT is being tried as the panacea. But can PIM/IMT help restore control of anarchy and atrophy in irrigation systems? Can institutional reforms ensure financial and physical sustainability? Can these help improve rehabilitation of Asia's surface irrigation systems? This review of 108 case studies shows that IMT/PIM is far from a panacea to all problems and that there is no magic formula for crafting successful WUAs. Our review of evidence from some decades of experiments is far from encouraging; by far the most celebrated experiments—catalyzed, sustained and micro-managed by NGO's with the help of unreplicable quality and scale of resources and donor support (e.g. Gal Oya in Sri Lanka, Baldeva LBMC in Gujarat) report only modest gains in terms of performance and sustainability, leading researchers to demand 'reform of reforms'.

Low, uncollected irrigation service fees, growing deferred maintenance, rampant anarchy and inequity in water distribution in Asian surface irrigation are symptoms of a larger malaise that PIM/IMT seem unable to address. Unlocking value from Asia's public irrigation capital demands a nuanced exploration of the farmer-system interplay in the context of today's socio-technical fundamentals which differ across Asia. Table 11 presents a first-cut view of socio-technical environment in which irrigation systems function in central Asia, South Asia, South-east Asia and China.

Table 11 Socio-technical environment of Asia's surface irrigation systems

	Central Asia	South Asia	South-east Asia	China
1) State's revenue interest in irrigation agriculture	High	Low	Low	Low
2) State's capacity to enforce discipline in irrigation systems	Some to high	Low	Low	High
3) Crops in irrigation commands	Cotton and/or wheat	Monsoon and summer rice, wheat, cotton, sugarcane, fodder, vegetables and fruit	Wet and dry season rice; high value market crops	Rice, wheat, vegetable, high value crops
4) Government compulsory 'levy' of irrigated crops	Yes	No	No	Not any more
5) Spread of pump irrigation within irrigation commands	low	Very high	High	High
6) Population pressure on farm land	Low	Very high	High	High
7) Ease of exit from farming	Low	Some	High	High
8) Core strategy for unlocking value	Improvise on estate-mode of irrigation farming with PIM or entrepreneurial model in distribution. The main constraint is poor infrastructure.	Adapt surface irrigation systems to support and sustain atomistic irrigation.	Modernize irrigation systems to support dry-season rice and diversified farming	Improvise and build upon the incentivized contractor model for distribution and fee collection.

Institutional reforms of the PIM/IMT kind appear to have best prospects in Central Asia especially if integrated in the estate-mode of irrigated agriculture that European colonial powers popularized in Africa. However, here the main constraint is the poor shape of the physical infrastructure and hence majority of our Central Asian cases turned out to be failures. Even here, IMT/PIM may not be best option, once the

Central Asian Republics liberalize and de-regulate their farm sector, they would eventually do, sooner or later.

In China, the model of contracting out distributaries to incentivized contractors seems to have produced better results compared to PIM; and this model needs to be improvised and built upon. The authority and backing of the Village Party Leader seems essential for such privatization to work; and for that reason, this model is unlikely to work in South Asia and South-east Asia. In South East Asia, the key may lie in upgrading and modernizing rice irrigation systems to support dry season rice cultivation as well as diversification of farming systems. There is growing evidence to show that Southeast Asia is going the South Asian way with the farmers increasingly opting for pumps and using them to draw water from other sources and use in conjunctively with water provided by gravity flow based public irrigation systems.

The situation in South Asia suggests that instead of institutional reforms, surface irrigation systems here themselves need to morph to fit in today's socio-technical context. For millennia, irrigation systems were 'supply-driven'. They offered a certain volume of water at certain times with certain dependability; and farmers had no option but to adapt their farming systems to these; they adapted because doing so was better than rainfed farming. Atomistic irrigation—offering water-on-demand year-round—has turned South Asian irrigation increasingly 'demand-driven', giving a whole new meaning to the term 'irrigation management'. With the option of 'exit' available, farmers in command areas are now reluctant to exercise 'voice' through PIM/IMT, refusing to give their loyalty to an irrigation regime that cannot provide them irrigation on-demand year-round. If we are to unlock the value hidden in South Asia's surface irrigation systems, they must morph in ways they can support and sustain the rising groundswell of atomistic irrigation; and by doing that secure the resources and cooperation they need from farmers to counter anarchy, atrophy and noise. If they themselves cannot become demand-driven, they should try integrating with a demand driven atomistic irrigation economy. This is already happening in many systems but by default; but much hidden value can be unlocked if this happens by deliberate design. This requires a paradigm shift in irrigation thinking and planning.

8. Conclusion

In this paper, we have reviewed 108 cases of IMT/PIM from 20 countries across Asia and found that successful cases of IMT/PIM occurs under a set of very context specific factors, factors that are either impossible to replicate, or very costly and therefore, impractical to replicate elsewhere. We find that the illusive search for magic formula of successful WUA yields no results and conclude that successful WUAs cannot be socially engineered. Ours is not the first study that concludes that IMT/PIM has had very mixed results. We are aware of numerous studies that concluded in same vein (FAO, 2007; Vermillion, 1997; Meinzen-Dick, 1997), but unlike those studies which suggested that problem with IMT/PIM lay in its implementation, we contend that there is a conceptual fault with this paradigm and it needs serious re-thinking on the part of the donors and national and international policy makers.

While not entirely dismissing the role of conventional IMT/PIM solutions in addressing some of the key problems in irrigation sector (after all 43 out of 108 were successful as per our definition, but of these as many as 16 were short term evaluations and hence not acceptable), we are of the view that IMT/PIM should not be treated as the magic potion aimed at curing the irrigation sector of all its ills. Instead, we make a case for exploring alternatives to IMT/PIM where IMT/PIM has not worked in the first instance. In case of dynamic agrarian economies moving towards high value crops, PPP may be a viable solution. Here Chinese models of providing incentives to the irrigation officials are of special relevance and worth emulating elsewhere. But, we are not sure how much of this incentivized entrepreneurial model can be replicated outside of China, but we do not rule it out either. This is especially so after the recent electricity sector reforms in India, where the previously unresponsive state electricity board officials have turned into professional service providers almost overnight after the reforms. We need a better understanding of the processes by which a bureaucratic organisation turns itself into a responsive organisation and see how those lessons can be used for reforming the irrigation sector. Unbundling of irrigation services, as has been done in one of the PPP examples from China is another promising model that needs to be explored further.

In poor, subsistent rice based economies of large parts of South and Southeast Asia, even PPP will not work, simply because the private sector will not be interested in engaging itself where prospects of cost recovery and profits are bleak. It is here that governments need to re-engage in irrigation management by treating irrigation water as a service delivery issue. This is easier said than done, because governments in poorer countries have the least capacity to provide high quality service. It is here that the donor agencies can contribute by strengthening the capacity of the national irrigation authorities and enable them to respond

to farmers demand. There is emerging evidence that it is possible to reform an organisation (see the case of electricity boards in India) and we need to understand how it can best be done with the irrigation agencies.

However, it is in the middle of the continuum (that is between the two extremes of high value dynamic agrarian sector and subsistence rice farming systems) much of Asia's irrigation economy lies. These regions of moderate dynamism and continuing high levels of poverty demand innovative solutions in irrigation management. It is also here that farmers are increasingly re-configuring the large scale public irrigation systems to meet their irrigation water demand. In all of South Asia and large parts of Southeast Asia, increasing use of groundwater and pumps has changed the face of irrigation economy. But this has gone largely unnoticed (or deliberately ignored, see Llamas 2003 for similar situation in Spain in 1980s) by the irrigation bureaucracy. We argue that unless the changed socio-technical foundation of Asia's irrigation is fully appreciated and farmers' innovations taken on board, reforming the public irrigation sector will remain only a piecemeal affair, as it has been so far.

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Appendix 2 - Location and identification details of the case study

Sr. No.	Country	Scheme	Year of publication	Authors	Type of case study (journal article, book chapter, conference paper, field notes and grey literature)	If Journal article, ISI ranked journal or not	IWMI and non-IWMI publication	Number of pages
1	Nepal	Khageri Irrigation System	2005	Bhatta et al.	Journal article	ISI	Non-IWMI	15
2	Japan	Toyogawa Irrigation Project	2007	Kono et al.	INPIM International Conference proceeding	n/a	Non-IWMI	12
3	Iran	Abhsar irrigation system	2007	Hoogesteger & Vincent	INPIM International Conference proceeding	n/a	Non-IWMI	7
4	Kyrgyzstan	Alexandrovka Village	2007	Lindberg	Diploma Thesis	n/a	Non-IWMI	136
5	Kyrgyzstan	Saz Village	2007	Lindberg	Diploma Thesis	n/a	Non-IWMI	136
6	Nepal	Andhi Khola Irrigation System	2007; 2002	Aryal & Rajouria, van Etten et al.	INPIM International Conference proceeding & IWMI Working Paper	n/a	IWMI and non IWMI	9 (non-IWMI) and 28 (IWMI) pages
7	China	Bayi Irrigation District	1998	Johnson III et al.	Journal article	ISI	Non-IWMI	22
8	China	Nanyao Irrigation District	1998	Johnson III et al.	Journal article	ISI	Non-IWMI	22
9	Pakistan	Hakra 4-R Distributary Canal	2003; 1998; undated	Hassan et al.; Zaman & Hamid; Hamid et al.	Journal article	No	IWMI	19, 147, 8
10	Japan	Fukuokazeki Land Improvement District (FLID)	2003	Tanaka and Soto	Journal article	ISI	Non-IWMI	6
11	India	Alod Minor, Gudha Medium Irrigation project, Rajasthan	2007	Tejawat and Gupta	INPIM International Conference proceeding & IWMI Working Paper	n/a	Non-IWMI	10
12	India	Danta Minor, Gudha Medium Irrigation project, Rajasthan	2007	Tejawat and Gupta	INPIM International Conference proceeding & IWMI Working Paper	n/a	Non-IWMI	11
13	India	LMC Minor No. 1, Gudha Medium Irrigation project, Rajasthan	2007	Tejawat and Gupta	INPIM International Conference proceeding & IWMI Working Paper	n/a	Non-IWMI	12

Sr. No.	Country	Scheme	Year of publication	Authors	Type of case study (journal article, book chapter, conference paper, field notes and grey literature)	If Journal article, ISI ranked journal or not	IWMI and non-IWMI publication	Number of pages
14	India	LMC Minor No. 2, Gudha Medium Irrigation project, Rajasthan	2007	Tejawat and Gupta	INPIM International Conference proceeding & IWMI Working Paper	n/a	Non-IWMI	13
15	Turkey	Bursa-Karacabey Irrigation Scheme	2009	Kuscu et al.	Journal article	Yes	Non-IWMI	9
16	Uzbekistan	Chikirchi-Angiarik WUA	2007	Veldwisch	Journal article	No	Non-IWMI	12
17	Kazakhstan	Shu Water User Association	Undated	Rosen and Strickland	Monograph	n/a	Non-IWMI	12
18	India	Sardar Sarovar Project	2007	Talati and Pandya	Journal article	non ISI	IWMI	8
19	Sri Lanka	Kirindi Oya Irrigation and Settlement Project	2007	Wijeyasundara et al.	INPIM International Conference proceeding	n/a	Non-IWMI	12
20	India	Sri Datta Water Distribution Co-operative Society, Maharashtra State	2006	McKay & Keremane	Journal article; IWMI IMT book Appendix	No	non-IWMI; IWMI	19, 3
21	Uzbekistan	South Ferghana Canal	2009	Abdullaev et al.	Journal article	ISI	IWMI	13
22	India	Three WUAs in Andhra Pradesh	2002	van Koppen et al.	IWMI Research Report	n/a	IWMI	36
23	India	Two WUAs from Pilot PIM Schemes in Gujarat	2002	van Koppen et al.	IWMI Research Report	n/a	IWMI	36
24	Nepal	Khageri Irrigation System			Book			
25	Nepal	Panchakanya Irrigation System			Book			
26	Nepal	Nepal West Gandak Irrigation System			Book			
27	India	Issar Minor irrigation Project	2003	Mukherji et al.	Fieldnotes and monograph	n/a	IWMI	2 to 3 pages each
28	India	Pingot Right Bank Irrigation Cooperative Society	2003	Mukherji et al.	Fieldnotes and monograph	n/a	IWMI	2 to 3 pages each

Sr. No.	Country	Scheme	Year of publication	Authors	Type of case study (journal article, book chapter, conference paper, field notes and grey literature)	If Journal article, ISI ranked journal or not	IWMI and non-IWMI publication	Number of pages
29	India	Pingot Left Bank Irrigation Cooperative Society	2003	Mukherji et al.	Fieldnotes and monograph	n/a	IWMI	2 to 3 pages each
30	India	Baldeva LBMC	2003	Mukherji et al.	Fieldnotes and monograph	n/a	IWMI	2 to 3 pages each
31	Turkey	Bursa Mustafakemalpasa Irrigation Scheme	2008	Kuscu et al.	Journal article	ISI	Non-IWMI	8
32	Indonesia	Kelara Karalloe, South Sulawesi	2007	Hasan & Mansoor	INPIM International Conference proceeding	n/a	Non-IWMI	13
33	Turkey	Lower Seyhan Plain	2001	Schuemann & Hasan	Project report to GTZ	n/a	IWMI	20
34	Turkey	Gendiz River Basin	2001	Schuemann & Hasan	Project report to GTZ	n/a	IWMI	20
35	Iran	Ravansar Right Bank Canal Irrigation System in Kermanshah Province	2007	Ul Hassan et al.	IWMI Working Paper	n/a	IWMI	42
36	Iran	WUA in Quazvin Province	2007	Ul Hassan et al.	IWMI Working Paper	n/a	IWMI	42
37	China	28 Bank WUA Candidate Villages	2008	Wang et al.	Project Report submitted to World Bank		non IWMI	78
38	China	15 Non-Bank WUA Candidate Villages	2008	Wang et al.	Project Report submitted to World Bank		non IWMI	78
39	Vietnam	Ngoila	2005	Trung et al.	Journal article	ISI	non-IWMI	12
40	Vietnam	N4B	2005	Trung et al.	Journal article	ISI	non-IWMI	12
41	Philippines	Capayas Irrigation System	2007	Maleza and Nishimura	Journal article	ISI	non-IWMI	8
42	Indonesia	Water Sufficient Area of the Tulungagung and Sidoarjo Regencies	2005	Pasaribu & Routray	Journal article	ISI	non-IWMI	20

Sr. No.	Country	Scheme	Year of publication	Authors	Type of case study (journal article, book chapter, conference paper, field notes and grey literature)	If Journal article, ISI ranked journal or not	IWMI and non-IWMI publication	Number of pages
43	Indonesia	Water Deficit Area of the Tulungagung and Sidoarjo Regencies	2005	Pasaribu & Routray	Journal article	ISI	non-IWMI	20
44	China	Six WUA in the Zhanghe Prefecture	Undated	Liu et al.	Unpublished article		non-IWMI	22
45	China	Four WUA in the Dongfeng Prefecture	Undated	Liu et al.	Unpublished article		non-IWMI	22
46	Philippines	46 IAs in 25 National Irrigation Systems over Six Provinces	2005	Fujiie et al.	Journal article	ISI	non-IWMI	11
47	Indonesia	Cipanumbangan Irrigation System in West Java	2000	Vermillion et al.	IWMI RR 38	n/a	IWMI	44
48	Indonesia	Cinangka II Irrigation System in West Java	2000	Vermillion et al.	IWMI RR 38	n/a	IWMI	44
49	Indonesia	Kaliduren System in Central Java	2000	Vermillion et al.	IWMI RR 38	n/a	IWMI	44
50	Indonesia	Planditan System in Central Java	2000	Vermillion et al.	IWMI RR 38	n/a	IWMI	44
51	Thailand	Khlong Thadi Weir System	2008	Ounvichit et al.	Journal article	ISI	non-IWMI	17
52	Indonesia	Tiroang Village (upstream area)	2006	Asian Productivity Organisation	Report of Asian Productivity Organisation	n/a	non-IWMI	249
53	Indonesia	Marawi Village (mid-stream area)	2006	Asian Productivity Organisation	Report of Asian Productivity Organisation	n/a	non-IWMI	249
54	Indonesia	Pakkie Village (lower-stream area)	2006	Asian Productivity Organisation	Report of Asian Productivity Organisation	n/a	non-IWMI	249

Sr. No.	Country	Scheme	Year of publication	Authors	Type of case study (journal article, book chapter, conference paper, field notes and grey literature)	If Journal article, ISI ranked journal or not	IWMI and non-IWMI publication	Number of pages
55	India	Anand District, Gujarat State	2003	Mukherji et al.	IWMI RR 69	n/a	IWMI	45
56	Bangladesh	Eight buried pipe irrigation schemes in Tangail	1997	Mridha et al.	Journal article	non ISI	non IWMI	9
57	Philippines	Guimba-Cuyapo Network	??	Flores & Mejia	?? Book chapter??	n/a	non-IWMI	8
58	Pakistan	Maira Branch Canal	2009	Latif & Tariq	Journal article	ISI	non-IWMI	12
59	Kyrgyzstan	Jalapak WUA	2009	Kazbekov et al.	Journal article	ISI	IWMI	9
60	Kyrgyzstan	Jani-Arik WUA	2009	Kazbekov et al.	Journal article	ISI	IWMI	9
61	Kyrgyzstan	Isan WUA	2009	Kazbekov et al.	Journal article	ISI	IWMI	9
62	India	Mohini WUA, Ukai Kakrapar	1995	Patel	Monograph, Planning Commission document and Appendix to a book	n/a	IWMI	20, 3
63	India	Bhima Lift irrigation WUA, Maharashtra	1995	Zala	Monograph and Appendix to a book	n/a	IWMI	20, 3
64	Laos	BanVuenTonhen	2007	Rasphone et al.	Journal article	No	non-IWMI	9
65	Cambodia	Tam Lap	2007	Perera et al.	Report submitted to AFD, Grey Literature	n/a	IWMI	
66	Cambodia	Banteay Thleay	2007	Perera et al.	Report submitted to AFD, Grey Literature	n/a	IWMI	
67	Cambodia	Kork Kandal	2007	Perera et al.	Report submitted to AFD, Grey Literature	n/a	IWMI	
68	Cambodia	Thoam Ney	2007	Perera et al.	Report submitted to AFD, Grey Literature	n/a	IWMI	
69	Cambodia	Thnoat Te	2007	Perera et al.	Report submitted to AFD, Grey Literature	n/a	IWMI	
70	Cambodia	Phlauv Touk	2007	Perera et al.	Report submitted to AFD, Grey Literature	n/a	IWMI	

Sr. No.	Country	Scheme	Year of publication	Authors	Type of case study (journal article, book chapter, conference paper, field notes and grey literature)	If Journal article, ISI ranked journal or not	IWMI and non-IWMI publication	Number of pages
71	Cambodia	Chan Thnal	2007	Perera et al.	Report submitted to AFD, Grey Literature	n/a	IWMI	
72	Cambodia	Seventh March	2007	Perera et al.	Report submitted to AFD, Grey Literature	n/a	IWMI	
73	Cambodia	Tumhub Santesok	2007	Perera et al.	Report submitted to AFD, Grey Literature	n/a	IWMI	
74	Malaysia	Kubang Depu	??	Kiet & Mat	Conference paper	n/a	Non-IWMI	
75	Sri Lanka	Moraketiya DC7, Embilipitiya Block of Uda Walawe Project	1998	Perera & Jinapala	Conference paper	n/a	IWMI	
76	Sri Lanka	Pubudu WUA in Kaudulla Irrigation System	??	Klozen	Report submitted to GTZ, Grey Literature	n/a	IWMI	
77	Sri Lanka	Diyawiddagama WUA in Mahaweli System C	??	Klozen	Report submitted to GTZ, Grey Literature	n/a	IWMI	
78	Sri Lanka	Nachchaduwa Oya	1999	Samad & Vermillion	IWMI RR 34	n/a	IWMI	
79	Sri Lanka	Hakwatuna Oya	1999	Samad & Vermillion	IWMI RR 34	n/a	IWMI	
80	Sri Lanka	Gal Oya Left Bank Farmers Organization	1999; 2000	Murray Rust et al.; Uphoff	Journal article	Yes	Non-IWMI	
81	Vietnam	La Khe Irrigation System	1998	Turrall et al.	Conference paper	n/a	Non-IWMI	
82	Thailand	Mae Kuang Irrigation System	??	Ounvichit	Book Chapter	n/a	Non-IWMI	
83	Uzbekistan	Akbarabad WUA	2004	Yakubov & Matyakubov	Survey Report, Grey Literature	n/a	IWMI	
84	Kyrgyzstan	Kerme-Too Akburasy WUA	2004	Yakubov & Matyakubov	Survey Report, Grey Literature	n/a	IWMI	
85	Tajikistan	Zafarshan WUA	2004	Yakubov & Matyakubov	Survey Report, Grey Literature	n/a	IWMI	

Sr. No.	Country	Scheme	Year of publication	Authors	Type of case study (journal article, book chapter, conference paper, field notes and grey literature)	If Journal article, ISI ranked journal or not	IWMI and non-IWMI publication	Number of pages
86	Philippines	Magat River Integrated Irrigation System	2007	Bandopadhyay et al.	Policy Research WP of the WB	n/a	Non-IWMI	
87	Philippines	Oriental Mindoro System	2005	Gragasin et al.	Journal article	NO	Non-IWMI	
88	China	Zhanghe Irrigation System	2008	Jianpeng et al.	Journal article	No	Non-IWMI	
89	India	XIth Branch Canal Periyar Vaigai Project	1995	Kannan	Case study report, grey literature	n/a	IWMI	
90	India	Mettupalayam Distributary in Lower Bhavani Project	1995	Sureshvaran	Case study report, grey literature	n/a	IWMI	
91	India	Panchanhangipatti Tank	1995	Neelavalli	Case study report, grey literature	n/a	IWMI	
92	Vietnam	WUA B8A	2004	Minh	Conference paper, FAO conference on PIM in Vietnam	n/a	Non-IWMI	3
93	Cambodia	Sopha main canal and station irrigation	2004	Sabuth and Solitha	Conference paper, FAO conference on PIM in Vietnam	n/a	Non-IWMI	2
94	India	Dusi Mamandur Tank	1995	Sivanandham	Case study report, grey literature	n/a	IWMI	20
95	India	Hadsi Minor	1995	Patole	Case study report, grey literature	n/a	IWMI	12
96	India	Jai Yogeshwar, Ozar, Waghad Project	2006; 1995	Keremane & McKay; Tikde	Journal article and IWMI monograph	ISI	non-IWMI	18
97	India	Navanad, Mohadi, Waghad Project	2006; 1995	Keremane & McKay; Tikde	Journal article	ISI	non-IWMI	18
98	India	Vir Bajrang Bali Pani Panchayat	2006	Mohapatra	Conference paper	n/a	non-IWMI	35
99	Kazakhstan	Shoymanova	2002	Thurman	Consultancy Report to the World Bank	n/a	non-IWMI	68
100	Kazakhstan	Otrar	2002	Thurman	Consultancy Report to	n/a	non-IWMI	68

Sr. No.	Country	Scheme	Year of publication	Authors	Type of case study (journal article, book chapter, conference paper, field notes and grey literature)	If Journal article, ISI ranked journal or not	IWMI and non-IWMI publication	Number of pages
					the World Bank			
101	Kazakhstan	N. Ilyasov	2002	Thurman	Consultancy Report to the World Bank	n/a	non-IWMI	68
102	Kyrgyzstan	Gulbaaar	2002	Thurman	Consultancy Report to the World Bank	n/a	non-IWMI	68
103	Uzbekistan	Pakhtaabad	2002	Thurman	Consultancy Report to the World Bank	n/a	non-IWMI	68
104	Uzbekistan	Dostlik	2002	Thurman	Consultancy Report to the World Bank	n/a	non-IWMI	68
105	Uzbekistan	Kirkkiz	2002	Thurman	Consultancy Report to the World Bank	n/a	non-IWMI	68
106	Thailand	IWUG 18R canal	2009	Teamsuwan & Satoh	Journal article	ISI	non-IWMI	11
107	Thailand	IWUG SHUAI	2009	Teamsuwan & Satoh	Journal article	ISI	non-IWMI	11
108	Thailand	WUA Ban Rom	2009	Teamsuwan & Satoh	Journal article	ISI	non-IWMI	11

Appendix 3 - Methodological indicators

Sr. No.	Country	Scheme	Objective of the case study	Captures perception of whom?	Method of study employed	Was there an independent measurement of outcomes & impacts?	Period between transfer and evaluation	Period between transfer and evaluation - categorized
1	Nepal	Khageri Irrigation System	Determine the performance of Farmer-managed irrigation systems as opposed to agency-managed	Authors	Before and after	Yes	4-5 years	Medium-term
2	Japan	Toyogawa Irrigation Project	Analyze the role sharing of farmers and government in water management in the Toyogawa irrigation project, which is the irrigation sector of the Toyogawa Water Resources Developing Project in Japan.	Authors	Description without comparison	No	n/a	n/a
3	Iran	Abhsar irrigation system	Describes the institutional transformations in farmer and agency action in the the Zayandeh Rud river basin and the Abshar Irrigation System.	Authors	Before and after	No	11	Long-term
4	Kyrgyzstan	Alexandrovka Village	IMT and how access to irrigation water influences the livelihoods of households.	Author and farmers	Before and after	No	9	Medium-term
5	Kyrgyzstan	Saz Village	IMT and how access to irrigation water influences the livelihoods of households.	Author and farmers	Before and after	No	9	Medium-term
6	Nepal	Andhi Khola Irrigation System	Different aspects of Irrigation development and related impacts on the socio-economic condition of landless people	Male and female water users, irrigation leaders, project staff, and other informants	Before and after	Yes	8	Medium-term
7	China	Bayi Irrigation District	How broader rural reforms have resulted in changes in irrigation management in China.	Authors	Before and after	Yes	3	Short-term

Sr. No.	Country	Scheme	Objective of the case study	Captures perception of whom?	Method of study employed	Was there an independent measurement of outcomes & impacts?	Period between transfer and evaluation	Period between transfer and evaluation - categorized
8	China	Nanyao Irrigation District	How broader rural reforms have resulted in changes in irrigation management in China.	Authors	Before and after	Yes	3	Short-term
9	Pakistan	Hakra 4-R Distributary Canal	Impact of IMT Case study II: aims at addressing the question if a proper awareness creation process shows a potential to encourage competent, smaller and medium users to participate in such organisations or if it still leaves domination of leadership of such organisations by big, influential and incompetent users.	Authors, farmers and government	Before and after	Yes	1 year before and right after	Short-term
10	Japan	Fukuokazeki Land Improvement District (FLID)	O & M issues in a LID and try to identify and describe the system that maintains public order in irrigation.	Irrigation staff and farmers	Description without comparison	No	Over 10 years	Long-term
11	India	Alod Minor, Gudha Medium Irrigation project, Rajasthan	Impacts of IMT	Farmers	Before and after	Yes	1	Short-term
12	India	Danta Minor, Gudha Medium Irrigation project, Rajasthan	Impacts of IMT	Farmers	Before and after	Yes	1	Short-term
13	India	LMC Minor No. 1, Gudha Medium Irrigation project, Rajasthan	Impacts of IMT	Farmers	Before and after	Yes	1	Short-term

Sr. No.	Country	Scheme	Objective of the case study	Captures perception of whom?	Method of study employed	Was there an independent measurement of outcomes & impacts?	Period between transfer and evaluation	Period between transfer and evaluation - categorized
14	India	LMC Minor No. 2, Gudha Medium Irrigation project, Rajasthan	Impacts of IMT	Farmers	Before and after	Yes	1	Short-term
15	Turkey	Bursa-Karacabey Irrigation Scheme	To assess the performance of irrigation water management of the Bursa-Karacabey irrigation scheme (KIS)	Farmers	Before and after	Yes	9	Medium-term
16	Uzbekistan	Chikirchi-Angiarik WUA	Analyse the structural changes made to the water distribution system moving from a system of complete state regulation to a system with partial privatisation.	Authors	With and without	No	2	Short-term
17	Kazakhstan	Shu Water User Association	This paper describes one answer to the challenge of irrigation water management at the local level by presenting the case of the Shu Water User Association (WUA).	Large farmers	Before and after	Yes	2	Short-term
18	India	Sardar Sarovar Project	The study attempts to understand the dynamics of canal irrigation management at the village service area in the absence of proper infrastructure development and institutional arrangements.	Authors	Description without comparison		less than 1 year	Short-term
19	Sri Lanka	Kirindi Oya Irrigation and Settlement Project	Not stated, but it essentially describes management changes towards participatory irrigation management systems and its consequences.	Authors	Description without comparison	Yes	4	Medium-term

Sr. No.	Country	Scheme	Objective of the case study	Captures perception of whom?	Method of study employed	Was there an independent measurement of outcomes & impacts?	Period between transfer and evaluation	Period between transfer and evaluation - categorized
20	India	Sri Datta Water Distribution Co-operative Society, Maharashtra State	The present paper is based on the study carried out to examine the institutional arrangements in one of the water users association that was first in the Maharashtra state.	Authors, farmers and ID officials	Description without comparison	No	16	Long-term
21	Uzbekistan	South Ferghana Canal	The main aim of the field research was to capture and document the changes in water management at the different levels due to the IWRM FV project interventions.	Authors, farmers and government	Before and after	Yes	3	Short-term
22	India	Three WUAs in Andhra Pradesh	Capture poverty dimensions in large-scale canal irrigation schemes under IMT.	Farmers	Before and after	No	2	Short-term
23	India	Two WUAs from Pilot PIM Schemes in Gujarat	Capture poverty dimensions in large-scale canal irrigation schemes under IMT.	Farmers	Before and after	No	4	Medium-term
24	Nepal	Khageri Irrigation System	??	Farmers	Before and after	Yes	8	Medium-term
25	Nepal	Panchakanya Irrigation System	??	Farmers	Before and after	Yes	6	Medium-term
26	Nepal	Nepal West Gandak Irrigation System	??	Farmers	Before and after	Yes	7	Medium-term
27	India	Issar Minor irrigation Project	Toevalueate the efficacy of PIM in a tribal-dominated area	Farmers, NGO and Irrigation department	Before and after	No	6	Medium-term

Sr. No.	Country	Scheme	Objective of the case study	Captures perception of whom?	Method of study employed	Was there an independent measurement of outcomes & impacts?	Period between transfer and evaluation	Period between transfer and evaluation - categorized
28	India	Pingot Right Bank Irrigation Cooperative Society	Toevalue the efficacy of PIM in a tribal-dominated area	Farmers, NGO and Irrigation department	Before and after	No	10	Long-term
29	India	Pingot Left Bank Irrigation Cooperative Society	Toevalue the efficacy of PIM in a tribal-dominated area	Farmers, NGO and Irrigation department	Before and after	No	6	Medium-term
30	India	Baldeva LBMC	Toevalue the efficacy of PIM in a tribal-dominated area	Farmers, NGO and Irrigation department	Before and after	No	9	Medium-term
31	Turkey	Bursa Mustafakemalpas a Irrigation Scheme	Evaluate the impacts of management transfer	Farmers	Before and after	Yes	6	Medium-term
32	Indonesia	Kelara Karalloe, South Sulawesi	A review of the lessons learned from farmer participation during post-rehabilitation operations	Authors	Before and after	No	3	Short-term
33	Turkey	Lower Seyhan Plain	To identify some key issues in the transfer of irrigation management	Authors	Description without comparison	No	7	Medium-term
34	Turkey	Gendiz River Basin	To identify some key issues in the transfer of irrigation management	Authors	Description without comparison	No	7	Medium-term
35	Iran	Ravansar Right Bank Canal Irrigation System in Kermanshah Province	Review the ongoing IMT efforts in the two provinces of Iran and propose a viable framework for implementing IMT.	Author	Description without comparison	Some (participation)	4 and 1	n/a
36	Iran	WUA in Quazvin Province	Review the ongoing IMT efforts in the two provinces of Iran and propose a viable framework for implementing	WUA leadership	Description without comparison	Some	4 and 3 and 2	n/a

Sr. No.	Country	Scheme	Objective of the case study	Captures perception of whom?	Method of study employed	Was there an independent measurement of outcomes & impacts?	Period between transfer and evaluation	Period between transfer and evaluation - categorized
			IMT.					
37	China	28 Bank WUA Candidate Villages	World Bank Commissioned study of WUAs with the overall goal to understand whether or not WUAs, in general, and the Bank-support WUAs, in particular, improve the effectiveness of water control in China's villages.	Farmers and community leaders	With and without	Yes	5 and 1	n/a
38	China	15 Non-Bank WUA Candidate Villages	World Bank Commissioned study of WUAs with the overall goal to understand whether or not WUAs, in general, and the Bank-support WUAs, in particular, improve the effectiveness of water control in China's villages.	Farmers and community leaders	With and without	Yes	5 and 1	n/a
39	Vietnam	Ngoila	The study was undertaken to evaluate three institutional models for the management of inter-commune and - district irrigation schemes.	Farmers	With and without	Yes	7	Medium-term
40	Vietnam	N4B	The study was undertaken to evaluate three institutional models for the management of inter-commune and - district irrigation schemes.	Farmers	With and without	Yes	7	Medium-term
41	Philippines	Capayas Irrigation System	Twin objectives: (1) to explore the participatory processes that took place when the irrigation management transfer policy was implemented in the NIS; and (2) to determine the factors affecting poor performance.	Members of irrigators associations	Description without comparison	No	3	Short-term
42	Indonesia	Water Sufficient Area of the Tulungagung and Sidoarjo	To study and assess the performance of the WUA	Farmers (households)	Description without comparison	No	max 16	Long-term

Sr. No.	Country	Scheme	Objective of the case study	Captures perception of whom?	Method of study employed	Was there an independent measurement of outcomes & impacts?	Period between transfer and evaluation	Period between transfer and evaluation - categorized
		Regencies						
43	Indonesia	Water Deficit Area of the Tulungagung and Sidoarjo Regencies	To study and assess the performance of the WUA	Farmers (households)	Description without comparison	No	max 16	Long-term
44	China	Six WUA in the Zhanghe Prefecture	Examine the economic benefits from WUAs and participatory irrigation management.	Farmers and WUA chairman	Before after	No	minimum 6	Medium-term
45	China	Four WUA in the Dongfeng Prefecture	Examine the economic benefits from WUAs and participatory irrigation management.	Farmers and WUA chairman	Before after	No	minimum 6	Medium-term
46	Philippines	46 IAs in 25 National Irrigation Systems over Six Provinces	What were the factors underlying success or failure in farmers' participation in O&M activities.	Leaders, farmers, irrigation officials	Description without comparison	No	n/a	n/a
47	Indonesia	Cipanumbangan Irrigation System in West Java	Examines to what extent these aspirations of the government and the farmers were realised through turnover program	Irrigation agency staff, farmers	Before after and with without	No	10	Long-term
48	Indonesia	Cinangka II Irrigation System in West Java	Examines to what extent these aspirations of the government and the farmers were realised through turnover program	Irrigation agency staff, farmers	Before after and with without	No	10	Long-term
49	Indonesia	Kaliduren System in Central Java	Examines to what extent these aspirations of the government and the farmers were realised through turnover program	Irrigation agency staff, farmers	Before after and with without	No	8	Medium-term
50	Indonesia	Planditan System in Central Java	Examines to what extent these aspirations of the government and the farmers were realised through turnover program	Irrigation agency staff, farmers	Before after and with without	No	8	Medium-term

Sr. No.	Country	Scheme	Objective of the case study	Captures perception of whom?	Method of study employed	Was there an independent measurement of outcomes & impacts?	Period between transfer and evaluation	Period between transfer and evaluation - categorized
51	Thailand	Khlong Thadi Weir System	Investigated the difficulties in organizing water users in the Khlong Thadi Weir System in southern Thailand	Farmers, their community leaders, state irrigation and local administration officers	Description without comparison	No	0	Short-term
52	Indonesia	Tiroang Village (upstream area)	The overall objective of this study is to understand and analyze the impact of the empowerment of WUA	WUA leadership; NGO and irrigation staff	Before after	No	1	Short-term
53	Indonesia	Marawi Village (mid-stream area)	The overall objective of this study is to understand and analyze the impact of the empowerment of WUA	WUA leadership; NGO and irrigation staff	Before after	No	1	Short-term
54	Indonesia	Pakkie Village (lower-stream area)	The overall objective of this study is to understand and analyze the impact of the empowerment of WUA	WUA leadership; NGO and irrigation staff	Before after	No	1	Short-term
55	India	Anand District, Gujarat State	To identify the factors that have helped in accelerating the transfer process and evaluate the performance of transferred tubewells against those owned by individuals and GWRDC (a government company).	GWRDC officials, farmers	Before after and with without	No	7	Medium-term

Sr. No.	Country	Scheme	Objective of the case study	Captures perception of whom?	Method of study employed	Was there an independent measurement of outcomes & impacts?	Period between transfer and evaluation	Period between transfer and evaluation - categorized
56	Bangladesh	Eight buried pipe irrigation schemes in Tangail	The objective was to carry out a detailed case study of management experiences of irrigated agriculture with BP distribution systems.	Tangail Agricultural Development Project staff	Description without comparison	No	n/a	n/a
57	Philippines	Guimba-Cuyapo Network	The paper presents the accomplishments and the recent developments in the operation and management of the Central Luzon Groundwater Irrigation Project irrigation pumps	Author	Description without comparison	No	n/a	n/a
58	Pakistan	Maira Branch Canal	The major objective of the present study was to assess the operational, managerial, agricultural and financial performance of six selected distributaries, where irrigation management has been transferred to the farmers.	Farmers	Before after	No	Assessment after 2 seasons of IMT	Short-term
59	Kyrgyzstan	Jalapak WUA	To evaluate the performance of WUAs	n/a	Description without comparison	No	4	Medium-term
60	Kyrgyzstan	Jani-Arik WUA	To evaluate the performance of WUAs	n/a	Description without comparison	No	4	Medium-term
61	Kyrgyzstan	Isan WUA	To evaluate the performance of WUAs	n/a	Description without comparison	No	4	Medium-term
62	India	Mohini WUA, Ukai Kakrapar	To evaluate the performance of WUAs	Authors	Before after and with without	No	14	Long-term
63	India	Bhima Lift irrigation WUA, Maharashtra	To evaluate the performance of WUAs	Authors, farmers	Description without comparison	No	3	Short-term

Sr. No.	Country	Scheme	Objective of the case study	Captures perception of whom?	Method of study employed	Was there an independent measurement of outcomes & impacts?	Period between transfer and evaluation	Period between transfer and evaluation - categorized
64	Laos	BanVuenTonhen	Role of farmers' community in managing irrigation both financially and socially	Authors	Time series analysis for 5 years	Yes	10	Long-term
65	Cambodia	Tam Lap	To develop M&E system for impact assessment of PIMD	Authors	Before and after	NO	7	Medium-term
66	Cambodia	Banteay Thleay	To develop M&E system for impact assessment of PIMD	Authors	Before and after	NO	11	Long-term
67	Cambodia	Kork Kandal	To develop M&E system for impact assessment of PIMD	Authors	Before and after	NO	4	Medium-term
68	Cambodia	Thoam Ney	To develop M&E system for impact assessment of PIMD	Authors	Before and after	NO	3	Short-term
69	Cambodia	Thnoat Te	To develop M&E system for impact assessment of PIMD	Authors	Before and after	NO	11	Long-term
70	Cambodia	Phlaurv Touk	To develop M&E system for impact assessment of PIMD	Authors	Before and after	NO	10	Long-term
71	Cambodia	Chan Thnal	To develop M&E system for impact assessment of PIMD	Authors	Before and after	NO	12	Long-term
72	Cambodia	Seventh March	To develop M&E system for impact assessment of PIMD	Authors	Before and after	NO	11	Long-term
73	Cambodia	Tumnub Santesok	To develop M&E system for impact assessment of PIMD	Authors	Before and after	NO	3	Short-term
74	Malaysia	Kubang Depu	To share experience of setting up of WUG in Besut Irrigation scheme by using the current case study as an example	Implementors	Before and after	No	7	Medium-term
75	Sri Lanka	Moraketiya DC7, Embilipitiya Block of Uda Walawe Project	To field test a community management model for handing over system management responsibilities to FO	Implementors	Description without comparison	Yes	1	Short-term
76	Sri Lanka	Pubudu WUA in Kaudulla Irrigation System	Reforms in financing O&M and whether IMT leads to better O&M investments	Authors	Before and after	No	7	Medium-term

Sr. No.	Country	Scheme	Objective of the case study	Captures perception of whom?	Method of study employed	Was there an independent measurement of outcomes & impacts?	Period between transfer and evaluation	Period between transfer and evaluation - categorized
77	Sri Lanka	Diyawiddagama WUA in Mahaweli System C	Reforms in financing O&M and whether IMT leads to better O&M investments	Authors	Before and after	No	4	Medium-term
78	Sri Lanka	Nachchaduwa Oya	Develop and apply a methodology for impact assessment of IMT	n/a	Before after and with without	Yes	6	Medium-term
79	Sri Lanka	Hakwatuna Oya	Develop and apply a methodology for impact assessment of IMT	n/a	Before after and with without	Yes	6	Medium-term
80	Sri Lanka	Gal Oya Left Bank Farmers Organization	To demonstrate benefits of social capital for irrigation management	Author	Before and after	Yes	17	Long-term
81	Vietnam	La Khe Irrigation System	Process followed to specify improved levels of irrigation service	Authors	Description without comparison	No	2	Short-term
82	Thailand	Mae Kuang Irrigation System	Describe people's participation in irrigation in Thailand	Authors	Description without comparison	No	10	Long-term
83	Uzbekistan	Akbarabad WUA	Baseline survey of 3 WUA's in CA to assess their performance	n/a	Description without comparison	Yes	2	Short-term
84	Kyrgyzstan	Kerme-Too Akburasy WUA	Baseline survey of 3 WUA's in CA to assess their performance	n/a	Description without comparison	Yes	2	Short-term
85	Tajikistan	Zafarshan WUA	Baseline survey of 3 WUA's in CA to assess their performance	n/a	Description without comparison	Yes	2	Short-term

Sr. No.	Country	Scheme	Objective of the case study	Captures perception of whom?	Method of study employed	Was there an independent measurement of outcomes & impacts?	Period between transfer and evaluation	Period between transfer and evaluation - categorized
86	Philippines	Magat River Integrated Irrigation System	to understand the farm level impacts of irrigation management transfer using a sample size of 61 irrigation associations and 1020 farm households	Authors and IMT implementors (World Bank)	With and without comparison with IV, econometric analysis	Yes	6	Medium-term
87	Philippines	Oriental Mindoro System	The effect of irrigation association on productivity of rice	Authors	With and without analysis using econometric techniques	No	7	Medium-term
88	China	Zhanghe Irrigation System	to evaluate WUA's performance		Statistical analysis without comparison	No	12	Long-term
89	India	XIth Branch Canal Periyar Vaigai Project	Farmers experience with WUAs	Author/Farmers	Description without comparison	No	5	Medium-term
90	India	Mettupalayam Distributary in Lower Bhavani Project	Farmers experience with WUAs	Author/Farmers	Description without comparison	No	7	Medium-term
91	India	Panchanhangipatti Tank	Farmers experience with WUAs	Author/Farmers	Description without comparison	No	3	Short-term
92	Vietnam	WUA B8A	Performance evaluation of a WUA	Authors	Description without comparison	No	5	Medium-term
93	Cambodia	Sopha main canal and station irrigation	Performance evaluation of a WUA	Authors	Description without comparison	No	2	Short-term
94	India	Dusi Mamandur Tank	Farmers experience with WUAs	Authors	Description without comparison	No	12	Long-term

Sr. No.	Country	Scheme	Objective of the case study	Captures perception of whom?	Method of study employed	Was there an independent measurement of outcomes & impacts?	Period between transfer and evaluation	Period between transfer and evaluation - categorized
95	India	Hadsi Minor	Farmers experience with WUAs	Authors and WUA chairman	Description without comparison	No	3	Short-term
96	India	Jai Yogeshwar, Ozar, Waghad Project	Self created rules and conflict management and impact of WUA	Authors and farmers	Before after	No	14	Long-term
97	India	Navanad, Mohadi, Waghad Project	Self created rules and conflict management	Authors and farmers	Description without comparison	No	12	Long-term
98	India	Vir Bajrang Bali Pani Panchayat	Evaluation of water management through community participation and emergence of Pani Panchayat	Authors and farmers	With and without	Yes	3	Short term
99	Kazakhstan	Shoymanova	Field assessment of irrigation networks in Central Asia	Authors and local farmers	Description without comparison	No	2	Short term
100	Kazakhstan	Otrar	Field assessment of irrigation networks in Central Asia	Authors and local farmers	Description without comparison	No	2	Short term
101	Kazakhstan	N. Ilyasov	Field assessment of irrigation networks in Central Asia	Authors and local farmers	Description without comparison	No	6	Medium term
102	Kyrgyzstan	Gulbaaar	Field assessment of irrigation networks in Central Asia	Authors and local farmers	Description without comparison	No	6	Medium term
103	Uzbekistan	Pakhtaabad	Field assessment of irrigation networks in Central Asia	Authors and local farmers	Description without comparison	No	3	Short term
104	Uzbekistan	Dostlik	Field assessment of irrigation networks in Central Asia	Authors and local farmers	Description without comparison	No	1	Short term

Sr. No.	Country	Scheme	Objective of the case study	Captures perception of whom?	Method of study employed	Was there an independent measurement of outcomes & impacts?	Period between transfer and evaluation	Period between transfer and evaluation - categorized
105	Uzbekistan	Kirkkiz	Field assessment of irrigation networks in Central Asia	Authors and local farmers	Description without comparison	No	6	Medium term
106	Thailand	IWUG 18R canal	Examine the activities of several award winning WUOs	Authors and local farmers	Before and after	No	5	Medium term
107	Thailand	IWUG SHUAI	Examine the activities of several award winning WUOs	Authors and local farmers	Before and after	No	9	Medium term
108	Thailand	WUA Ban Rom	Examine the activities of several award winning WUOs	Authors and local farmers	Before and after	No	37	Long term

Appendix 4 - Technical specification of the schemes

Sr. No.	Country	Scheme	Type of scheme	Size of scheme	Size of scheme - categorized	Scheme complexity	Age of the scheme from the date to construction to year of study	Year of construction/ commissioning
1	Nepal	Khageri Irrigation System	Diversion	3,830	Large	Complex	24	1967
2	Japan	Toyogawa Irrigation Project	Storage	16,000	Large	Complex	37	1968
3	Iran	Abhsar irrigation system	Storage	270,000	Large	Complex	35	1971
4	Kyrgyzstan	Alexandrovka Village	n/a	4,600	Large	Simple	n/a	n/a
5	Kyrgyzstan	Saz Village	n/a	547	Medium	Complex	n/a	n/a
6	Nepal	Andhi Khola Irrigation System	Diversion	282	Small	Complex	28	1989
7	China	Bayi Irrigation District	Storage	5,333	Large	Complex	33	1967
8	China	Nanyao Irrigation District	n/a	2,473	Large	Complex	40	1958
9	Pakistan	Hakra 4-R Distributary Canal	Storage	17,600	Large	Complex	n/a	n/a
10	Japan	Fukuokazeki Land Improvement District (FLID)	Diversion	6,320	Large	Complex	100	17th century
11	India	Alod Minor, Gudha Medium Irrigation project, Rajasthan	n/a	251	Small	Complex	45	1958
12	India	Danta Minor, Gudha Medium Irrigation project, Rajasthan	n/a	536	Medium	Complex	45	1958
13	India	LMC Minor No. 1, Gudha Medium Irrigation project, Rajasthan	n/a	367	Small	Complex	45	1958

Sr. No.	Country	Scheme	Type of scheme	Size of scheme	Size of scheme - categorized	Scheme complexity	Age of the scheme from the date to construction to year of study	Year of construction/ commissioning
14	India	LMC Minor No. 2, Gudha Medium Irrigation project, Rajasthan	n/a	464	Small	Complex	45	1958
15	Turkey	Bursa-Karacabey Irrigation Scheme	Diversión	16,683	Large	Complex	28	1989
16	Uzbekistan	Chikirchi-Angiarik WUA	n/a	2000	Large	Complex	n/a	n/a
17	Kazakhstan	Shu Water User Association	Storage	450	Small	Complex	17	1980
18	India	Sardar Sarovar Project	Storage	n/a	Large	Complex	3	2004
19	Sri Lanka	Kirindi Oya Irrigation and Settlement Project	Storage	9,430	Large	Complex	20	1986
20	India	Sri Datta Water Distribution Co-operative Society, Maharashtra State	Storage	361	Small	Complex	n/a	n/a
21	Uzbekistan	South Ferghana Canal	Storage	96,215	Large	Complex	57	1940
22	India	Three WUAs in Andhra Pradesh	Storage	4,025	Large	Complex	n/a	n/a
23	India	Two WUAs from Pilot PIM Schemes in Gujarat	Storage	721	Medium	Complex	n/a	n/a
24	Nepal	Khageri Irrigation System	Diversión	3,900	Large	Complex	n/a	1967
25	Nepal	Panchakanya Irrigation System	Storage	600	Medium	Complex	n/a	1974
26	Nepal	Nepal West Gandak Irrigation System	Storage	8,700	Large	Complex	n/a	1973
27	India	Issar Minor irrigation Project	Storage	273	Small	Simple	27	1975-76
28	India	Pingot Right Bank Irrigation Cooperative Society	Storage	275	Small	Simple	18	1985

Sr. No.	Country	Scheme	Type of scheme	Size of scheme	Size of scheme - categorized	Scheme complexity	Age of the scheme from the date to construction to year of study	Year of construction/ commissioning
29	India	Pingot Left Bank Irrigation Cooperative Society	Storage	360	Small	Simple	18	1985
30	India	Baldeva LBMC	Storage	455	Small	Simple	13	1990
31	Turkey	Bursa Mustafakemalpasa Irrigation Scheme	Diversion	16,550	Large	Complex	38	1967
32	Indonesia	Kelara Karalloe, South Sulawesi	Diversion	7,004	Large	Complex	40	early 1970s
33	Turkey	Lower Seyhan Plain	n/a	n/a	n/a	n/a	35	n/a
34	Turkey	Gendiz River Basin	n/a	n/a	n/a	n/a	35	n/a
35	Iran	Ravansar Right Bank Canal Irrigation System in Kermanshah Province	n/a	2,700	Large	Complex	n/a	n/a
36	Iran	WUA in Quazvin Province	n/a	n/a	n/a	Complex	n/a	n/a
37	China	28 Bank WUA Candidate Villages	n/a	n/a	n/a	Complex	n/a	n/a
38	China	15 Non-Bank WUA Candidate Villages	n/a	n/a	n/a	Complex	n/a	n/a
39	Vietnam	Ngoila	Storage	392	Small	Complex	n/a	n/a
40	Vietnam	N4B	Diversion	230	Small	Complex	n/a	n/a
41	Philippines	Capayas Irrigation System	Storage	750	Medium	Complex	10	1993
42	Indonesia	Water Sufficient Area of the Tulungagung and Sidoarjo Regencies	Storage	n/a	n/a	n/a	n/a	n/a
43	Indonesia	Water Deficit Area of the Tulungagung and Sidoarjo Regencies	Storage	n/a	n/a	n/a	n/a	n/a
44	China	Six WUA in the Zhanghe Prefecture	n/a	3,447	Large	Complex	n/a	n/a
45	China	Four WUA in the Dongfeng Prefecture	n/a	13,120	Large	Complex	n/a	n/a

Sr. No.	Country	Scheme	Type of scheme	Size of scheme	Size of scheme - categorized	Scheme complexity	Age of the scheme from the date to construction to year of study	Year of construction/ commissioning
46	Philippines	46 IAs in 25 National Irrigation Systems over Six Provinces	Diversion	1,553	Medium	Complex	n/a	n/a
47	Indonesia	Cipanumbangan Irrigation System in West Java	Diversion	150	Small	Simple	26	1970
48	Indonesia	Cinangka II Irrigation System in West Java	Diversion	441	Small	Simple	16	1980
49	Indonesia	Kaliduren System in Central Java	Diversion	193	Small	Simple	78	1918
50	Indonesia	Planditan System in Central Java	Diversion	131	Small	Simple	78	1918
51	Thailand	Khlong Thadi Weir System	Diversion	31,552	Large	Complex	17	1988
52	Indonesia	Tiroang Village (upstream area)	Storage	2,445	Large	Complex	65	1939
53	Indonesia	Marawi Village (mid-stream area)	Storage	1,119	Medium	Complex	65	1939
54	Indonesia	Pakkie Village (lower-stream area)	Storage	694	Medium	Complex	65	1939
55	India	Anand District, Gujarat State	Tubewells	n/a	n/a	Simple	28	1975
56	Bangladesh	Eight buried pipe irrigation schemes in Tangail	Buried pipe system	n/a	n/a	Simple	3	1985-1988
57	Philippines	Guimba-Cuyapo Network	Pump systems	935	Medium	Simple	n/a	mid-1970s
58	Pakistan	Maira Branch Canal	Storage	n/a	n/a	Complex	88	1917-1918
59	Kyrgyzstan	Jalapak WUA	Storage	8,477	Large	Complex	n/a	n/a
60	Kyrgyzstan	Jani-Arik WUA	Storage	8,477	Large	Complex	n/a	n/a
61	Kyrgyzstan	Isan WUA	Storage	8,477	Large	Complex	n/a	n/a

Sr. No.	Country	Scheme	Type of scheme	Size of scheme	Size of scheme - categorized	Scheme complexity	Age of the scheme from the date to construction to year of study	Year of construction/ commissioning
62	India	Mohini WUA, Ukai Kakrapar	Storage	337	Small	Simple	25	1971
63	India	Bhima Lift irrigation WUA, Maharashtra	Storage	217	Small	Simple	15	1980
64	Laos	BanVuenTonhen	Lift irrigation using electric pump	550	Medium	Simple	18	1989
65	Cambodia	Tam Lap	Storage	2,197	Large	Complex	30	1977
66	Cambodia	Banteay Thleay	Pumping	1,314	Medium	Simple	n/a	n/a
67	Cambodia	Kork Kandal	Storage	783	Medium	Complex	n/a	n/a
68	Cambodia	Thoam Ney	Storage	325	Small	Simple	57	1950
69	Cambodia	Thnoat Te	Storage	3200	Large	Complex	31	1976
70	Cambodia	Phlauv Touk	Pumping	3501	Large	Complex	31	1976
71	Cambodia	Chan Thnal	Storage	1000	Medium	Complex	31	1976
72	Cambodia	Seventh March	Storage	1878	Medium	Complex	31	1976
73	Cambodia	Tumnub Santesok	Storage	65	Small	Simple	32	1975
74	Malaysia	Kubang Depu	Storage	90	Small	Simple	15	1977
75	Sri Lanka	Moraketiya DC7, Embilipitiya Block of Uda Walawe Project	Storage	77	Small	Simple	n/a	n/a
76	Sri Lanka	Pubudu WUA in Kaudulla Irrigation System	Storage	286	Small	Simple	36	1958
77	Sri Lanka	Diyawiddagama WUA in Mahaweli System C	Storage	194	Small	Simple	12	1982
78	Sri Lanka	Nachchaduwa Oya	Storage/Tank	2383	Large	Complex	90	1906
79	Sri Lanka	Hakwatuna Oya	Storage/Tank	2407	Large	Complex	40	1960
80	Sri Lanka	Gal Oya Left Bank Farmers Organization	Storage/Tank	16328	Large	Complex	37	1960
81	Vietnam	La Khe Irrigation System	Pumping	13000	Large	Complex	33	1962

Sr. No.	Country	Scheme	Type of scheme	Size of scheme	Size of scheme - categorized	Scheme complexity	Age of the scheme from the date to construction to year of study	Year of construction/ commissioning
82	Thailand	Mae Kuang Irrigation System	Diversion	28000	Large	Complex	3	1992
83	Uzbekistan	Akbarabad WUA	Storage	2820	Large	Complex	n/a	n/a
84	Kyrgyzstan	Kerme-Too Akburasy WUA	Storage	2070	Large	Complex	n/a	n/a
85	Tajikistan	Zafarshan WUA	Storage	1050	Large	Complex	n/a	n/a
86	Philippines	Magat River Integrated Irrigation System	Storage	218 (average area under each IA)	Small	Simple	n/a	n/a
87	Philippines	Oriental Mindoro System	n/a	2800	Large	Complex	45	1960
88	China	Zhanghe Irrigation System	Storage	160000 ha	Large	Complex	41	1966
89	India	Xlth Branch Canal Periyar Vaigai Project	Storage tank through a canal	857	Medium	Complex	100	1896
90	India	Mettupalayam Distributary in Lower Bhavani Project	Storage	80970	Large	Complex	48	1948-1953
91	India	Panchanhangipatti Tank	Storage tank	14	Small	Simple	60	1945
92	Vietnam	WUA B8A	n/a	401	Small	Simple	n/a	n/a
93	Cambodia	Sopha main canal and station irrigation	Diversion with pump	318	Small	Simple	36	1976-78
94	India	Dusi Mamandur Tank	Storage tank with canals	1667	Large	Complex	100	Ancient
95	India	Hadsi Minor	River diversion	n/a	n/a	Simple	15	1980
96	India	Jai Yogeshwar, Ozar, Waghad Project	Storage	595	Medium	Complex	25	1980
97	India	Navanad, Mohadi, Waghad Project	Storage	n/a	n/a	Complex	25	1980

Sr. No.	Country	Scheme	Type of scheme	Size of scheme	Size of scheme - categorized	Scheme complexity	Age of the scheme from the date to construction to year of study	Year of construction/ commissioning
98	India	Vir Bajrang Bali Pani Panchayat	Lift irrigation	50	Small	Simple	n/a	n/a
99	Kazakhstan	Shoymanova	Storage	n/a	n/a	Complex	40	1960's to 1980s
100	Kazakhstan	Otrar	Storage	n/a	n/a	Complex	40	1960's to 1980s
101	Kazakhstan	N. Ilyasov	Storage	n/a	n/a	Complex	40	1960's to 1980s
102	Kyrgyzstan	Gulbaaar	Storage	n/a	n/a	Complex	40	1960's to 1980s
103	Uzbekistan	Pakhtaabad	Storage	n/a	n/a	Complex	40	1960's to 1980s
104	Uzbekistan	Dostlik	Storage	n/a	n/a	Complex	40	1960's to 1980s
105	Uzbekistan	Kirrkiz	Storage	n/a	n/a	Complex	40	1960's to 1980s
106	Thailand	IWUG 18R canal	Diversion	2640	Large	Complex	n/a	n/a
107	Thailand	IWUG SHUAI	Pump and lift irrigation	3003	Large	Simple	n/a	n/a
108	Thailand	WUA Ban Rom	Diversion	3210	Large	Complex	n/a	n/a

Appendix 5 - Socio-economic and agricultural characteristics of the schemes

Sr. No.	Country	Scheme	Major crop(s)	Crop systems	Number of farmers/households or population served by the scheme	Physical water scarcity	GDP/capita (PPP US\$)	Importance of agriculture in people's livelihood	Social cohesion	Average size of land holding ha	Year of transfer/formation of WUA/initiation of PIM
1	Nepal	Khageri Irrigation System	Rice	Paddy	5038	n/a	1550	High	n/a	0.97	1996
2	Japan	Toyogawa Irrigation Project	Paddy	Paddy	n/a	Yes	31267	Low	n/a	n/a	n/a
3	Iran	Abhsar irrigation system	Rice	Paddy	n/a	n/a	7968	Low	High	n/a	1993
4	Kyrgyzstan	Alexandrovka Village	Wheat, barley, sugar beet, maize, sunflower, alfalfa, fruits, vegetables	Non-paddy	14754	Yes	1927	High	Low	0.3	1996
5	Kyrgyzstan	Saz Village	Wheat, barley, sugar beet, maize, sunflower, alfalfa, fruits, vegetables	Non-paddy	2025	Yes	1927	High	n/a	n/a	mid-1990s
6	Nepal	Andhi Khola Irrigation System	Maize, pulses, millet	Non-paddy	500	n/a	1550	High	Low	0.5	1997
7	China	Bayi Irrigation District	Wheat, maize, cotton, vegetables, watermelons, orchard crops	Non-paddy	90200	n/a	6757	Medium	n/a	n/a	mid-1980s

8	China	Nanyao Irrigation District	Wheat, maize, cotton, vegetables, watermelons, orchard crops	Non-paddy	35545	n/a	6757	n/a	n/a	n/a	late 80s, early 90s
9	Pakistan	Hakra 4-R Distributary Canal	Cotton, sugarcane, rice, wheat, clovers, sorghum, millet, maize	Non-paddy	6000	n/a	2370	High	Low	2 ha	2000
10	Japan	Fukuokazeki Land Improvement District (FLID)	Rice	Paddy	n/a	n/a	31267	Very low	n/a	n/a	1949
11	India	Alod Minor, Gudha Medium Irrigation project, Rajasthan	Sugarcane, wheat, pea (vegetable), lentil, gram, mustard and fodder	Non-paddy	125	Yes	3452	High	n/a	2	1999-2000
12	India	Danta Minor, Gudha Medium Irrigation project, Rajasthan	Sugarcane, wheat, pea (vegetable), lentil, gram, mustard and fodder	Non-paddy	150	Yes	3452	High	n/a	3.6	1999-2000
13	India	LMC Minor No. 1, Gudha Medium Irrigation project, Rajasthan	Sugarcane, wheat, pea (vegetable), lentil, gram, mustard and fodder	Non-paddy	135	Yes	3452	High	n/a	2.7	1999-2000
14	India	LMC Minor No. 2, Gudha Medium Irrigation project, Rajasthan	Sugarcane, wheat, pea (vegetable), lentil, gram, mustard and fodder	Non-paddy	165	Yes	3452	High	n/a	2.8	1999-2000

15	Turkey	Bursa-Karacabey Irrigation Scheme	Maize (corn) and vegetables	Non-paddy	n/a	Yes	8407	n/a	n/a	2.5	1998
16	Uzbekistan	Chikirchi-Angiarik WUA	Cotton, wheat, orchards, alfalfa, melons, potatoes, vegetables, rice	Non-paddy	n/a	n/a	2063	High	n/a	0.25	2003-2004
17	Kazakhstan	Shu Water User Association	Wheat, hay, melon, barley, maize	Non-paddy	37	n/a	7780	High	n/a	12	Late 1996
18	India	Sardar Sarovar Project	Cotton, wheat, tobacco	Non-paddy	n/a	No	3452	High			2003-2004
19	Sri Lanka	Kirindi Oya Irrigation and Settlement Project	Paddy	Paddy	5000	Yes	4595	High	Low	n/a	1999
20	India	Sri Datta Water Distribution Co-operative Society, Maharashtra State	Sugarcane, jowar, wheat, bajra, and groundnut	Non-paddy	400	Yes	3452	High	70% Maratha but also other castes	1.36	1989
21	Uzbekistan	South Ferghana Canal	Cotton, wheat, rice, fruits and vegetables	Non-paddy	n/a	n/a	2063	n/a	n/a	n/a	2003
22	India	Three WUAs in Andhra Pradesh	Paddy, maize, cotton, chili and groundnut	Non-paddy	721	n/a	3452	High	n/a	below 5 ha	1997
23	India	Two WUAs from Pilot PIM Schemes in Gujarat	Wheat, cash crops, mustard and tobacco	Non-paddy	4025	Yes	3452	High	n/a	n/a	1995

24	Nepal	Khageri Irrigation System	Paddy, wheat	Paddy	??	Yes	1550	High	High	0.3	1993
25	Nepal	Panchakanya Irrigation System	Paddy	Paddy	??	Yes	1550	High	n/a	0.5	1995
26	Nepal	Nepal West Gandak Irrigation System	Rice, wheat and sugarcane	Paddy	??	No	1550	High	n/a	0.5	1997
27	India	Issar Minor irrigation Project	Sugarcane, groundnut, greengram, wheat, vegetables	Non-paddy	366	n/a	3452	High	High	0.75	1995-96
28	India	Pingot Right Bank Irrigation Cooperative Society	Sugarcane, groundnut, greengram, wheat, vegetables	Non-paddy	216	Yes	3452	High	n/a	2.57	1991-92
29	India	Pingot Left Bank Irrigation Cooperative Society	Sugarcane, groundnut, greengram, wheat, vegetables	Non-paddy	294	Yes	3452	High	n/a	1.05	1995-96
30	India	Baldeva LBMC	Sugarcane, groundnut, greengram, wheat, vegetables	Non-paddy	186	n/a	3452	High	High	2.44	1992-93
31	Turkey	Bursa Mustafakemalpasa Irrigation Scheme	n/a	n/a	3800	Yes	8407	n/a	n/a	2.5	1998
32	Indonesia	Kelara Karalloe, South Sulawesi	Paddy	Paddy	11264	Yes	3843	High	n/a	n/a	2003
33	Turkey	Lower Seyhan Plain	n/a	n/a	n/a	No	8407	n/a	n/a	n/a	1993-94***
34	Turkey	Gendiz River Basin	Cotton	Non-paddy	n/a	Yes	8407	n/a	High	n/a	1993-94***

35	Iran	Ravansar Right Bank Canal Irrigation System in Kermanshah Province	Wheat and barley	Non-paddy	1140	n/a	7968	n/a	n/a	Below 5 ha	2000 and 2003
36	Iran	WUA in Quazvin Province	Wheat and barley	Non-paddy	n/a	n/a	7968	n/a	n/a	n/a	2003-2004-2005
37	China	28 Bank WUA Candidate Villages	Wheat, rice, maize	Non-paddy	n/a	n/a	6757	n/a	n/a	n/a	1995- 2005
38	China	15 Non-Bank WUA Candidate Villages	Wheat, rice, maize	Non-paddy	n/a	n/a	6757	n/a	n/a	n/a	1995- 2006
39	Vietnam	Ngoila	Paddy in spring and rainfed upland crops in winter	Paddy	2 312	n/a	3071		High	0.28	1996
40	Vietnam	N4B	Paddy in spring and rainfed upland crops in winter	Paddy	1 252	n/a	3071		High	0.28	1996
41	Philippines	Capayas Irrigation System	Paddy	Paddy	n/a	Yes	5137	High	n/a	0.7	2000
42	Indonesia	Water Sufficient Area of the Tulungagung and Sidoarjo Regencies	Paddy	Paddy	n/a	n/a	3843	High	n/a	0.26	Approx 1989
43	Indonesia	Water Deficit Area of the Tulungagung and Sidoarjo Regencies	Paddy	Paddy	n/a	n/a	3843	High	n/a	0.26	Approx 1989
44	China	Six WUA in the Zhanghe Prefecture	Paddy	Paddy	4 584	n/a	6757	n/a	n/a	n/a	2000-2003

45	China	Four WUA in the Dongfeng Prefecture	Paddy	Paddy	24 530	n/a	6757	n/a	n/a	n/a	2000-2003
46	Philippines	46 IAs in 25 National Irrigation Systems over Six Provinces	n/a	n/a	n/a	n/a	5137	n/a	n/a or low	1 ha	n/a (after 1981)
47	Indonesia	Cipanumbangan Irrigation System in West Java	Rice	Paddy	101	n/a	3843	n/a	n/a	0.38	June 1990
48	Indonesia	Cinangka II Irrigation System in West Java	Rice	Paddy	1217	n/a	3843	n/a	n/a	0.2-0.35	June 1990
49	Indonesia	Kaliduren System in Central Java	Rice	Paddy	n/a	n/a	3843	n/a	n/a	0.07-0.17	October 1992
50	Indonesia	Planditan System in Central Java	Rice	Paddy	404	n/a	3843	n/a	n/a	0.14	October 1992
51	Thailand	Khlong Thadi Weir System	Paddy	Paddy	n/a	n/a	8677	Moderate	Low	0.31	2004
52	Indonesia	Tiroang Village (upstream area)	Rice	Paddy	5 255	n/a	3843	High	n/a	0.25-3	2003
53	Indonesia	Marawi Village (mid-stream area)	Rice	Paddy	4 044	n/a	3843	High	n/a	0.25-3	2003
54	Indonesia	Pakkie Village (lower-stream area)	Rice	Paddy	2 801	n/a	3843	High	n/a	0.25-3	2003
55	India	Anand District, Gujarat State	Paddy, tobacco, banana, wheat, coarse cereals	Non-paddy	n/a	n/a	3452	n/a	n/a	Below 1 ha	1995
56	Bangladesh	Eight buried pipe irrigation schemes in Tangail	Paddy, vegetables	Paddy	354	n/a	2053	n/a	n/a	n/a	1985-1988
57	Philippines	Guimba-Cuyapo	Rice	Paddy	n/a	n/a	5137	n/a	n/a	Below 1 ha	1986

		Network									
58	Pakistan	Maira Branch Canal	Maize, tobacco, wheat, sugarcane	Non-paddy	5586	n/a	2370	n/a	n/a	2 ha	2003
59	Kyrgyzstan	Jalapak WUA	Vegetables, maize, wheat	Non-paddy	4 876	n/a	1927	n/a	n/a	1.5	2003
60	Kyrgyzstan	Jani-Arik WUA	Vegetables, maize, wheat	Non-paddy	1 037	n/a	1927	n/a	n/a	1.5	2003
61	Kyrgyzstan	Isan WUA	Vegetables, maize, wheat	Non-paddy	3 940	n/a	1927	n/a	n/a	1.5	2003
62	India	Mohini WUA, Ukai Kakrapar	Sugarcane	Non-paddy	282	No	3452	High	High,	0.7 ha	1978
63	India	Bhima Lift irrigation WUA, Maharashtra	Sugarcane, jowar, wheat, bajra	Non-paddy	63	Yes	3452	High	High,	n/a	1990
64	Laos	BanVuenTonhen	Paddy, paddy-cash crop, only cash crop and tobacco	Non-paddy	268	NO	500	n/a	High	n/a	1997
65	Cambodia	Tam Lap	Paddy	Paddy	2394	Inadequate	480	n/a	n/a	0.9	2000
66	Cambodia	Banteay Thleay	Paddy	Paddy	1877	Adequate	480	n/a	n/a	0.7	1996
67	Cambodia	Kork Kandal	Paddy	Paddy	1461	Inadequate	480	n/a	n/a	0.5	2003
68	Cambodia	Thoam Ney	Paddy	Paddy	284	Adequate	480	n/a	n/a	1	2004
69	Cambodia	Thnoat Te	Paddy	Paddy	1904	Inadequate	480	n/a	n/a	1	1996
70	Cambodia	Phlaur Touk	Paddy	Paddy	2924	Adequate	480	n/a	n/a	1	1997
71	Cambodia	Chan Thnal	Paddy	Paddy	2300	Adequate	480	n/a	n/a	0.3	1995
72	Cambodia	Seventh March	Paddy	Paddy	1180	Inadequate	480	n/a	n/a	1.2	1996
73	Cambodia	Tumnub Santesok	Paddy	Paddy	103	Inadequate	480	n/a	n/a	0.5	2004
74	Malaysia	Kubang Depu	Paddy	Paddy	72	n/a	5490	Low	n/a	1.26	1992

75	Sri Lanka	Moraketiya DC7, Embilipitiya Block of Uda Walawe Project	Banana	Non-paddy	79	No	1300	High	Yes	n/a	1991-1994
76	Sri Lanka	Pubudu WUA in Kaudulla Irrigation System	Paddy	Paddy	377	Yes, in dry Yala season	1300	High	n/a	0.8	1986
77	Sri Lanka	Diyawiddagama WUA in Mahaweli System C	Paddy	Paddy	n/a	No	1300	High	n/a	1	1990
78	Sri Lanka	Nachchaduwa Oya	Paddy	Paddy	3027	n/a	1300	n/a	n/a	0.5-6	1990
79	Sri Lanka	Hakwatuna Oya	Paddy	Paddy	2178	n/a	1300	n/a	n/a	2	1990
80	Sri Lanka	Gal Oya Left Bank Farmers Organization	Paddy	Paddy	n/a	Yes	1300	High	High	n/a	1982
81	Vietnam	La Khe Irrigation System	Paddy	Paddy	n/a	n/a	690	n/a	n/a	n/a	1997
82	Thailand	Mae Kuang Irrigation System	Paddy	Paddy	11184	n/a	2990	n/a	Low	n/a	1995
83	Uzbekistan	Akbarabad WUA	Orchards, cotton, winter wheat, vegetables	Non-paddy	16034	Yes	610	High	n/a	2.2	2002
84	Kyrgyzstan	Kerme-Too Akburasy WUA	Orchards, cotton, winter wheat, vegetables	Non-paddy	5585	Yes	490	High	n/a	n/a	2002
85	Tajikistan	Zafarshan WUA	Orchards, cotton, winter wheat, vegetables	Non-paddy	1966	Yes	390	High	n/a	5.2	2002
86	Philippines	Magat River Integrated Irrigation System	Paddy	Paddy	165	n/a	1420	n/a	n/a	1.3	1997
87	Philippines	Oriental Mindoro	Paddy	Paddy	n/a	n/a	1420	High	Yes	1.7	1993

		System									
88	China	Zhanghe Irrigation System	summer rice, winter rapeseed	Non-paddy		No	6757	High	n/a	3	1995
89	India	XIth Branch Canal Periyar Vaigai Project	Paddy	Non-paddy	375	Yes	3452	High	n/a	n/a	1989
90	India	Mettupalayam Distributary in Lower Bhavani Project	Paddy, groundnut	Paddy	n/a	Yes	3452	High	Low	0.6-1.0	1987
91	India	Panchanthatangipatti Tank	Paddy, groundnut	Paddy	48	Yes	3452	High	High	Less than 0.2 ha	1991
92	Vietnam	WUA B8A	Paddy	Paddy	350	n/a	690	High	n/a	n/a	1998
93	Cambodia	Sopha main canal and station irrigation	Paddy	Paddy	301	n/a	480	High	n/a	n/a	2002
94	India	Dusi Mamandur Tank	Paddy, groundnut	Paddy	18000	Yes	3452	High	Low	n/a	1980
95	India	Hadsa Minor	Paddy, wheat, gram, vegetables	Non-paddy	1500	n/a	3452	n/a	Low	n/a	1991
96	India	Jai Yogeshwar, Ozar, Waghada Project	Strawberry, sunflower, grapes, sunflower	Non-paddy	291	Yes	3452	High	High	2.05	1991
97	India	Navanad, Mohadi, Waghada Project	Non paddy (high value crops)	Non-paddy	457	Yes	3452	High	High	2.46	1993
98	India	Vir Bajrang Bali Pani Panchayat	Paddy	Paddy	63	n/a	3452	High	n/a	1.82	2001-02
99	Kazakhstan	Shoymanova	cotton-corn	Non-paddy	n/a	Yes	7780	n/a	n/a	n/a	1999
100	Kazakhstan	Otrar	cotton-corn	Non-paddy	n/a	Yes	7780	n/a	n/a	n/a	1999
101	Kazakhstan	N. Ilyasov	rice-alfalfa-cereals	Non-paddy	n/a	Yes	7780	n/a	n/a	n/a	1995
102	Kyrgyzstan	Gulbaaar	cereals-corn	Non-paddy	n/a	Yes	490	n/a	n/a	n/a	1995
103	Uzbekistan	Pakhtaabad	cotton-cereals	Non-paddy	n/a	Yes	610	n/a	n/a	n/a	1998

104	Uzbekistan	Dostlik	cotton-cereals	Non-paddy	n/a	Yes	610	n/a	n/a	n/a	2001
105	Uzbekistan	Kirkkiz	cotton-cereals	Non-paddy	n/a	Yes	610	n/a	n/a	n/a	1995
106	Thailand	IWUG 18R canal	Paddy	Paddy	1100	No	2990	n/a	n/a	n/a	2001
107	Thailand	IWUG SHUAI	Paddy	Paddy	564	No	2990	n/a	n/a	n/a	1997
108	Thailand	WUA Ban Rom	Paddy	Paddy	509	No	2990	n/a	n/a	n/a	1969

Appendix 6 - PIM and IMT related indicators

Sr. No.	Country	Scheme	Highest hydraulic level transferred * Source FAO	Amount of O&M authority transferred * Source FAO	Initiator	Implementor	Rehabilitation before or during transfer	Training and capacity-building	Was a farmer's organisation created before the transfer (1=Yes, 0=No)	Was there a supporting legislation before the transfer? (1=Yes, 0=No)	WUA Chairman are elected, Yes or No
1	Nepal	Khageri Irrigation System	Headworks	Full	n/a	n/a	n/a	n/a	1	1	n/a
2	Japan	Toyogawa Irrigation Project	Main/branch	Full	Farmers	n/a	n/a	n/a	1	1	Elected
3	Iran	Abhsar irrigation system	Distributary	n/a	Government	n/a	n/a	n/a	0	n/a	Elected
4	Kyrgyzstan	Alexandrovka Village	Distributary	Full	Donor	n/a	n/a	n/a	1	1	Elected
5	Kyrgyzstan	Saz Village	Distributary	Full	Donor	n/a	n/a	n/a	0	1	n/a
6	Nepal	Andhi Khola Irrigation System	Headworks	Full	Government	Government	No	Yes	1	1	Elected
7	China	Bayi Irrigation District	Distributary	Partial	Government	Government	No	n/a	1	1	n/a
8	China	Nanyao Irrigation District	Distributary	Partial	Government	Government	Yes, some	n/a	1	1	n/a
9	Pakistan	Hakra 4-R Distributary Canal	Main/branch	Full	Government	Donor	Yes, some	Yes	1	1	Elected
10	Japan	Fukuokazeki Land Improvement District (FLID)	Main/branch	Full	Farmers	n/a	n/a	No	1	1	Elected
11	India	Alod Minor, Gudha Medium Irrigation project, Rajasthan	Distributary	Partial	Donor	Donor	Yes	Yes	1	1	Elected
12	India	Danta Minor, Gudha Medium Irrigation project, Rajasthan	Distributary	Partial	Donor	Donor	Yes	Yes	1	1	Elected
13	India	LMC Minor No. 1, Gudha Medium Irrigation project, Rajasthan	Distributary	Partial	Donor	Donor	Yes	Yes	1	1	Elected

Sr. No.	Country	Scheme	Highest hydraulic level transferred * Source FAO	Amount of O&M authority transferred * Source FAO	Initiator	Implementor	Rehabilitation before or during transfer	Training and capacity-building	Was a farmer's organisation created before the transfer (1=Yes, 0=No)	Was there a supporting legislation before the transfer? (1=Yes, 0=No)	WUA Chairman are elected, Yes or No
14	India	LMC Minor No. 2, Gudha Medium Irrigation project, Rajasthan	Distributary	Partial	Donor	Donor	Yes	Yes	1	1	Elected
15	Turkey	Bursa-Karacabey Irrigation Scheme	Main	Full	Government	n/a	No	n/a	1	n/a	n/a
16	Uzbekistan	Chikirchi-Angiarik WUA	n/a	Partial	Government	n/a	n/a	n/a	1	0	n/a
17	Kazakhstan	Shu Water User Association	Main/branch	n/a	Farmers/Donor	Donor	No	Yes	1	n/a	Elected
18	India	Sardar Sarovar Project	Distributary	Partial	Government	n/a	Not needed	n/a	1	1	
19	Sri Lanka	Kirindi Oya Irrigation and Settlement Project	Distributary	Partial	Government	n/a	n/a	n/a	1	1	Selected
20	India	Sri Datta Water Distribution Co-operative Society, Maharashtra State	Main/branch	Partial	Donor	n/a	n/a	n/a	1	1	Elected
21	Uzbekistan	South Ferghana Canal	Distributary	Partial	Donor	Donor (NGO)	No	Yes	1	0	Elected
22	India	Three WUAs in Andhra Pradesh	Distributary	Full	Government	Government	Yes	Yes	1	1	Elected
23	India	Two WUAs from Pilot PIM Schemes in Gujarat	Distributary	Partial	Government	Government or NGO	n/a	Yes	1	1	Elected
24	Nepal	Khageri Irrigation System	Headworks	Full	Donor	Government	No	Yes	1	1	Selected
25	Nepal	Panchakanya Irrigation System	Headworks	Full	Donor	Government	Yes	Yes	1	1	Selected
26	Nepal	Nepal West Gandak Irrigation System	Headworks	Full	Donor	Government	No	Yes.	1	1	Selected

Sr. No.	Country	Scheme	Highest hydraulic level transferred * Source FAO	Amount of O&M authority transferred * Source FAO	Initiator	Implementor	Rehabilitation before or during transfer	Training and capacity-building	Was a farmer's organisation created before the transfer (1=Yes, 0=No)	Was there a supporting legislation before the transfer? (1=Yes, 0=No)	WUA Chairman are elected, Yes or No
27	India	Issar Minor irrigation Project	Main	Full	Donor (NGO)	Donor (NGO)	Yes	Yes	1	1	Selected
28	India	Pingot Right Bank Irrigation Cooperative Society	Main	Full	Donor (NGO)	Donor (NGO)	Not needed	n/a	1	1	Selected
29	India	Pingot Left Bank Irrigation Cooperative Society	Main	Full	Farmers	Donor (NGO)	No	No	1	1	Selected
30	India	Baldeva LBMC	Main	Full	Donor (NGO)	Donor (NGO)	n/a	Yes	1	1	Selected
31	Turkey	Bursa Mustafakemalpasa Irrigation Scheme	Main	Full	Government	n/a	n/a	n/a	1	1	n/a
32	Indonesia	Kelara Karalloe, South Sulawesi	Distributary	Full	Government	NGO	Yes	Yes	1	1	n/a
33	Turkey	Lower Seyhan Plain	Main	Full	Government	Government	No	Yes	1	1	Elected
34	Turkey	Gendiz River Basin	Main	Full	Government	Government	No	Yes	1	1	Elected
35	Iran	Ravansar Right Bank Canal Irrigation System in Kermanshah Province	Distributary	n/a	Government	Government	n/a	Yes	1	n/a	n/a
36	Iran	WUA in Quazvin Province	Main	n/a	Government	Government	No	Yes	1	n/a	n/a
37	China	28 Bank WUA Candidate Villages	Distributary	Partial	Donor	Donor and government	n/a	Yes	1	1	Selected
38	China	15 Non-Bank WUA Candidate Villages	n/a	n/a	n/a	Government	n/a	Yes	1	1	Selected
39	Vietnam	Ngoila	Distributary	n/a	Government	n/a	n/a	n/a	1	n/a	n/a
40	Vietnam	N4B	Main/branch	n/a	Government	n/a	n/a	n/a	1	n/a	Elected
41	Philippines	Capayas Irrigation System	Main/branch		Government	Government	n/a	Yes	1	1	Election

Sr. No.	Country	Scheme	Highest hydraulic level transferred * Source FAO	Amount of O&M authority transferred * Source FAO	Initiator	Implementor	Rehabilitation before or during transfer	Training and capacity-building	Was a farmer's organisation created before the transfer (1=Yes, 0=No)	Was there a supporting legislation before the transfer? (1=Yes, 0=No)	WUA Chairman are elected, Yes or No
42	Indonesia	Water Sufficient Area of the Tulungagung and Sidoarjo Regencies	n/a	Full	Government	n/a	n/a	n/a	1	1	n/a
43	Indonesia	Water Deficit Area of the Tulungagung and Sidoarjo Regencies	Headworks	Full	Government	n/a	n/a	n/a	1	1	n/a
44	China	Six WUA in the Zhanghe Prefecture	Main	Full	Donor	Government and donor	n/a	Yes	1	1	Elected
45	China	Four WUA in the Dongfeng Prefecture	Distributary	Partial	Donor	Government and donor	n/a	Yes	1	1	Elected
46	Philippines	46 IAs in 25 National Irrigation Systems over Six Provinces	n/a	Partial	Government	Government	n/a	Yes	1	1	n/a
47	Indonesia	Cipanumbangan Irrigation System in West Java	Headworks	Full	Donor	Government	Yes, some	Yes	1	1	Elected
48	Indonesia	Cinangka II Irrigation System in West Java	Headworks	Full	Donor	Government	Yes, some	Yes	1	1	Elected
49	Indonesia	Kaliduren System in Central Java	Headworks	Full	Donor	Government	Yes, some	Yes	1	1	Elected
50	Indonesia	Planditan System in Central Java	Headworks	Full	Donor	Government	Yes, some	Yes	1	1	Elected
51	Thailand	Khlong Thadi Weir System	Main/branch	n/a	Government	Government	Yes	Yes, but not adequate	1	1**	Elected
52	Indonesia	Tiroang Village (upstream area)	Distributary	Full	Donor	NGO	Yes	Yes	1	1	Elected
53	Indonesia	Marawi Village (mid-stream area)	Distributary	Full	Donor	NGO	Yes	Yes	1	1	Elected

Sr. No.	Country	Scheme	Highest hydraulic level transferred * Source FAO	Amount of O&M authority transferred * Source FAO	Initiator	Implementor	Rehabilitation before or during transfer	Training and capacity-building	Was a farmer's organisation created before the transfer (1=Yes, 0=No)	Was there a supporting legislation before the transfer? (1=Yes, 0=No)	WUA Chairman are elected, Yes or No
54	Indonesia	Pakkie Village (lower-stream area)	Distributary	Full	Donor	NGO	No	Yes	1	1	Elected
55	India	Anand District, Gujarat State	Main	Full	Government	Government	No	No	1	1	Selected
56	Bangladesh	Eight buried pipe irrigation schemes in Tangail	Main	Full	Government	n/a	Not needed	n/a	1	n/a	Selected
57	Philippines	Guimba-Cuyapo Network	Distributary	Partial	Government	Government	Yes	Yes	1	1	n/a
58	Pakistan	Maira Branch Canal	Main/branch	Full	Government	n/a	Yes	n/a	1	1	n/a
59	Kyrgyzstan	Jalapak WUA	Main/branch	Full	Donor	n/a	Yes	Yes	1	1	n/a
60	Kyrgyzstan	Jani-Arik WUA	Main/branch	Full	Donor	n/a	Yes	Yes	1	1	n/a
61	Kyrgyzstan	Isan WUA	Main/branch	Full	Donor	n/a	n/a	Yes	1	1	n/a
62	India	Mohini WUA, Ukai Kakrapar	Main/branch	Partial	Government	Farmers	Yes	n/a	1	1	Elected
63	India	Bhima Lift irrigation WUA, Maharashtra	Distributary	Partial	Government	Farmers	n/a	Yes	1	0	Elected
64	Laos	BanVuenTonhen	Main	n/a	Government	n/a	n/a	n/a	1	1	n/a
65	Cambodia	Tam Lap	Main	Partial	Government	n/a	1	n/a	1	1	Selected
66	Cambodia	Banteay Thleay	n/a	Partial	Donor (PRASAC)	n/a	1	n/a	1	1	Election
67	Cambodia	Kork Kandal	n/a	Partial	Government	n/a	1	n/a	1	1	Election
68	Cambodia	Thoam Ney	Distributary	Partial	Government	n/a	1	n/a	1	1	Election
69	Cambodia	Thnoat Te	Main	Partial	Donor (ADB)	n/a	1	n/a	1	1	Election
70	Cambodia	Phlaurv Touk	n/a	Partial	Donor (PRASAC)	n/a	1	n/a	1	1	Election
71	Cambodia	Chan Thnal	Main	Partial	Donor (PRASAC)	n/a	1	n/a	1	1	Election
72	Cambodia	Seventh March	Main	Partial	Donor	n/a	1	n/a	1	1	Election

Sr. No.	Country	Scheme	Highest hydraulic level transferred * Source FAO	Amount of O&M authority transferred * Source FAO	Initiator	Implementor	Rehabilitation before or during transfer	Training and capacity-building	Was a farmer's organisation created before the transfer (1=Yes, 0=No)	Was there a supporting legislation before the transfer? (1=Yes, 0=No)	WUA Chairman are elected, Yes or No
					(PRASAC)						
73	Cambodia	Tumub Santesok	Main	Partial	Government	n/a	1	n/a	1	1	Election
74	Malaysia	Kubang Depu	Main	n/a	Government	n/a	n/a	Yes	1	1	Election
75	Sri Lanka	Moraketiya DC7, Embilipitiya Block of Uda Walawe Project	Distributary	Partial	Government and IIMI	IIMI	Yes	1	1	0	Selected
76	Sri Lanka	Pubudu WUA in Kaudulla Irrigation System	Distributary	Partial	Donor (USAID)	Government, Irrigation Management Department	Yes	n/a	1	1	Selected
77	Sri Lanka	Diyawiddagama WUA in Mahaweli System C	Main	Partial	Mahaweli Economic Authority (Government)	Government	Yes	n/a	1	1	Selected
78	Sri Lanka	Nachchaduwa Oya	Main	Partial	Government	Government	Yes	Yes	Yes	1	Selected
79	Sri Lanka	Hakwatuna Oya	Main	Partial	Government	Government	No	Yes	Yes	1	Selected
80	Sri Lanka	Gal Oya Left Bank Farmers Organization	Main	Partial	Donor (USAID)	Government	Yes	Yes (very extensive 3 year long)	Yes (with a lot of social mobilisation activity)	0	Selected
81	Vietnam	La Khe Irrigation System	Main	n/a	n/a	Government	n/a	Yes	Yes	1	n/a
82	Thailand	Mae Kuang Irrigation System	n/a	n/a	Government	Government	Yes	n/a	Yes	Yes	n/a
83	Uzbekistan	Akbarabad WUA	Distributary	Partial	Donors	Donors	n/a	n/a	Yes	Yes	n/a
84	Kyrgyzstan	Kerme-Too Akburasy WUA	Distributary	Full	Donors	Donors	n/a	n/a	Yes	Yes	n/a
85	Tajikistan	Zafarshan WUA	Distributary	n/a	Donors	Donors	n/a	n/a	Yes	Yes	n/a
86	Philippines	Magat River Integrated Irrigation System	Distributary	Partial	Donors (World Bank)	Donor and government	Yes	Yes	Yes	Yes	n/a
87	Philippines	Oriental Mindoro	Distributary	Partial	Donors (World Bank)	Donor and government	n/a	n/a	Yes	Yes	n/a

Sr. No.	Country	Scheme	Highest hydraulic level transferred * Source FAO	Amount of O&M authority transferred * Source FAO	Initiator	Implementor	Rehabilitation before or during transfer	Training and capacity-building	Was a farmer's organisation created before the transfer (1=Yes, 0=No)	Was there a supporting legislation before the transfer? (1=Yes, 0=No)	WUA Chairman are elected, Yes or No
		System			Bank)	government					
88	China	Zhanghe Irrigation System	Distributary	Full	Government	Government	n/a	n/a	1 (WUA)	0	Selected
89	India	Xlth Branch Canal Periyar Vaigai Project	Distributary	Partial	Government	Government	Yes	Yes	Yes	No	Selected
90	India	Mettupalayam Distributary in Lower Bhavani Project	Distributary	Partial	Government	Government	Yes	Yes by a Philippine s returned engineer	Yes	No	No
91	India	Panchanhangipatti Tank	Main	Full	Government	NGO (Pradan)	n/a	No	Yes	No	Selected
92	Vietnam	WUA B8A	Main	n/a	Government	Government	n/a	n/a	Yes	Yes	Yes
93	Cambodia	Sopha main canal and station irrigation	Distributary	Partial	Donor (ADB)	Donor (ADB)	Yes	n/a	Yes	n/a	n/a
94	India	Dusi Mamandur Tank	Distributary	Partial	Farmers	Farmers	No	No	Yes	No	Selected
95	India	Hadsi Minor	Distributary	Partial	NGO	Farmers	No	n/a	Yes	No	Selected
96	India	Jai Yogeshwar, Ozar, Waghad Project	Distributary	Partial	NGO (SOPPECOM)	Farmers	Yes	Yes	Yes	No	Elected
97	India	Navanad, Mohadi, Waghad Project	Distributary	Partial	NGO (SPK)	Farmers	n/a	Yes	Yes	No	Elected
98	India	Vir Bajrang Bali Pani Panchayat	Headworks	Full	Government	Government	n/a	No	Yes	Yes	Selected
99	Kazakhstan	Shoymanova	Distributary	n/a	Government	Government	No	n/a	Yes	n/a	n/a
100	Kazakhstan	Otrar	Distributary	n/a	Government	Government	No	n/a	Yes	n/a	n/a
101	Kazakhstan	N. Ilyasov	Distributary	n/a	Government	Government	No	n/a	Yes	n/a	n/a
102	Kyrgyzstan	Gulbaaar	Distributary	Full	Government	Government	No	n/a	Yes	n/a	n/a
103	Uzbekistan	Pakhtaabad	Distributary	Partial	Government	Government	No	n/a	Yes	n/a	n/a
104	Uzbekistan	Dostlik	Distributary	Partial	Government	Government	No	n/a	Yes	n/a	n/a
105	Uzbekistan	Kirkkiz	Distributary	Partial	Government	Government	No	n/a	Yes	n/a	n/a
106	Thailand	IWUG 18R canal	Distributary	n/a	Donor (JICA)	Donor	Yes	Yes	Yes	Yes	Yes
107	Thailand	IWUG SHUAI	Distributary	n/a	Farmers	Farmers	Yes	n/a	Yes	Yes	Yes

Sr. No.	Country	Scheme	Highest hydraulic level transferred * Source FAO	Amount of O&M authority transferred * Source FAO	Initiator	Implementor	Rehabilitation before or during transfer	Training and capacity-building	Was a farmer's organisation created before the transfer (1=Yes, 0=No)	Was there a supporting legislation before the transfer? (1=Yes, 0=No)	WUA Chairman are elected, Yes or No
108	Thailand	WUA Ban Rom	Distributary	n/a	Government	Government	Yes	Yes	Yes	No	n/a

Appendix 7 - Outcome and impact indicators and Composite Success Score (CSS)

Scheme identification			Outcome related indicators								Impact related indicators	Composite success score
Sr. No.	Country	Name of the scheme	Irrigation service fees and collection rates	Financial viability of WUA	Functional condition of irrigation infrastructure	Equity	Reliability and or adequacy	Popular awareness and support for WUA policies and decisions and for WUA leaders	Frequency of disputes	Crop-related impacts	Livelihoods and household impacts	Normalized success score
1	Nepal	Khageri Irrigation System in the Chitwan district	n/a	0	1	1	n/a	n/a	0	1	1	6.7
2	Japan	New irrigation areas of the Toyogawa Irrigation Project, Central Japan	n/a	1	n/a	1	n/a	1	n/a	1	n/a	10.0
3	Iran	Zayanhed Rud basin	n/a	n/a	0	n/a	n/a	1	n/a	0	n/a	3.3
4	Kyrgyzstan	Alexandrovka village, Chui Oblast	n/a	n/a	n/a	0	1	0	n/a	n/a	n/a	3.3
5	Kyrgyzstan	Saz Village	0	0	0	0	n/a	1	n/a	n/a	n/a	2.0
6	Nepal	Andhi Khola Irrigation System	n/a	n/a	n/a	0	n/a	0	n/a	1	0	2.5
7	China	Bayi Irrigation District	1	1	n/a	n/a	n/a	n/a	n/a	1	1	10.0
8	China	Nanyao Irrigation District	1	1	n/a	n/a	n/a	n/a	n/a	1	1	10.0
9	Pakistan	Hakra 4-R Distributary Canal	1	n/a	1	1	1	1	n/a	1	n/a	10.0
10	Japan	Fukuokazeki Land Improvement District (FLID)	n/a	n/a	n/a	1	n/a	1	1	0	n/a	7.5

Scheme identification			Outcome related indicators								Impact related indicators	Composite success score
Sr. No.	Country	Name of the scheme	Irrigation service fees and collection rates	Financial viability of WUA	Functional condition of irrigation infrastructure	Equity	Reliability and or adequacy	Popular awareness and support for WUA policies and decisions and for WUA leaders	Frequency of disputes	Crop-related impacts	Livelihoods and household impacts	Normalized success score
11	India	Alod Minor, Gudha Medium Irrigation project, Rajasthan	1	1	1	1	1	1	1	1	n/a	10.0
12	India	Danta Minor, Gudha Medium Irrigation project, Rajasthan	1	1	1	1	1	1	1	1	n/a	10.0
13	India	LMC Minor No. 1, Gudha Medium Irrigation project, Rajasthan	1	1	1	1	1	1	1	1	n/a	10.0
14	India	LMC Minor No. 2, Gudha Medium Irrigation project, Rajasthan	1	1	1	1	1	1	1	1	n/a	10.0
15	Turkey	Bursa-Karacabey Irrigation Scheme	1	1	1	1	1	1	n/a	0	n/a	8.6
16	Uzbekistan	Chikirchi-Angiarik WUA	1	1	n/a	n/a	n/a	0	n/a	0	n/a	5.0
17	Kazakhstan	Shu Water User Association (one of the first self-governing organizations of irrigators in	0	0	0	n/a	n/a	1	n/a	1	n/a	4.0

Scheme identification			Outcome related indicators								Impact related indicators	Composite success score
Sr. No.	Country	Name of the scheme	Irrigation service fees and collection rates	Financial viability of WUA	Functional condition of irrigation infrastructure	Equity	Reliability and or adequacy	Popular awareness and support for WUA policies and decisions and for WUA leaders	Frequency of disputes	Crop-related impacts	Livelihoods and household impacts	Normalized success score
		Kazakstan)										
18	India	Sardar Sarovar Project (SSR) - REGIONAL	0	0	n/a	n/a	n/a	0	n/a	0	n/a	0.0
19	Sri Lanka	Kirindi Oya Irrigation and Settlement Project - REGIONAL	n/a	n/a	n/a	n/a	0	n/a	n/a	1	0	3.3
20	India	Sri Datta Water Distribution Co-operative Society, Mula irrigation project in Ahmednagar district, Maharashtra state	0	1	0	n/a	n/a	0	n/a	n/a	n/a	2.5
21	Uzbekistan	South Ferghana Canal (SFC)	0	0	n/a	1	n/a	1	1	n/a	n/a	6.0

Scheme identification			Outcome related indicators								Impact related indicators	Composite success score
Sr. No.	Country	Name of the scheme	Irrigation service fees and collection rates	Financial viability of WUA	Functional condition of irrigation infrastructure	Equity	Reliability and or adequacy	Popular awareness and support for WUA policies and decisions and for WUA leaders	Frequency of disputes	Crop-related impacts	Livelihoods and household impacts	Normalized success score
		(REGIONAL)										
22	India	Three WUAs in Andhra Pradesh (Andhra Pradesh WUA1, Andhra Pradesh WUA2 and Andhra Pradesh WUA3) are from the Telangana, Coastal and Rayalseema.	n/a	n/a	n/a	1	n/a	0	n/a	0	n/a	3.3
23	India	Two WUAs from pilot PIM schemes in the dry north Gujarat region (Gujarat WUA1 and Gujarat WUA2) and two from the central south region (Gujarat WUA3 and Gujarat WUA4)	0	n/a	n/a	1	n/a	0	n/a	1	n/a	5.0
24	Nepal	Khageri Irrigation System (KIS)	0	n/a	1	1	1	1	n/a	1	n/a	8.3

Scheme identification			Outcome related indicators								Impact related indicators	Composite success score
Sr. No.	Country	Name of the scheme	Irrigation service fees and collection rates	Financial viability of WUA	Functional condition of irrigation infrastructure	Equity	Reliability and or adequacy	Popular awareness and support for WUA policies and decisions and for WUA leaders	Frequency of disputes	Crop-related impacts	Livelihoods and household impacts	Normalized success score
25	Nepal	Panchakanya Irrigation System (PIS)	1	1	1	1	n/a	1	n/a	1	n/a	10.0
26	Nepal	Nepal West Gandak Irrigation System (NWGIS)	0	0	0	0	0	0	n/a	0	n/a	0.0
27	India	Issar Minor irrigation Project	1	n/a	n/a	0	n/a	n/a	n/a	1	1	6.0
28	India	Pingot Right Bank Irrigation Cooperative Society	1	n/a	0 (The societies do only routine maintenance work (desilting and jungle cutting) and very minor repairs. But for anything like a canal breach or lining work, they look forward to government	n/a	n/a	n/a	0	1	1	6.0

Scheme identification			Outcome related indicators								Impact related indicators	Composite success score
Sr. No.	Country	Name of the scheme	Irrigation service fees and collection rates	Financial viability of WUA	Functional condition of irrigation infrastructure	Equity	Reliability and or adequacy	Popular awareness and support for WUA policies and decisions and for WUA leaders	Frequency of disputes	Crop-related impacts	Livelihoods and household impacts	Normalized success score
					intervention, even if they have a robust corpus fund with them.)							
29	India	Pingot Left Bank Irrigation Cooperative Society	n/a	n/a	1 (The societies do only routine maintenance work (desilting and jungle cutting) and very minor repairs. But for anything like a canal breach or lining work,	n/a	n/a	n/a	0	1	1	5.0

Scheme identification			Outcome related indicators								Impact related indicators	Composite success score
Sr. No.	Country	Name of the scheme	Irrigation service fees and collection rates	Financial viability of WUA	Functional condition of irrigation infrastructure	Equity	Reliability and or adequacy	Popular awareness and support for WUA policies and decisions and for WUA leaders	Frequency of disputes	Crop-related impacts	Livelihoods and household impacts	Normalized success score
					they look forward to government intervention, even if they have a robust corpus fund with them.)							
30	India	Baldeva LBMC	1	1	1 (The societies do only routine maintenance work (desilting and jungle cutting) and very minor repairs. But for anything like a canal breach or lining work,	n/a	n/a	n/a	1	1	1	8.3

Scheme identification			Outcome related indicators								Impact related indicators	Composite success score
Sr. No.	Country	Name of the scheme	Irrigation service fees and collection rates	Financial viability of WUA	Functional condition of irrigation infrastructure	Equity	Reliability and or adequacy	Popular awareness and support for WUA policies and decisions and for WUA leaders	Frequency of disputes	Crop-related impacts	Livelihoods and household impacts	Normalized success score
					they look forward to government intervention, even if they have a robust corpus fund with them.)							
31	Turkey	Bursa Mustafakemalpas,a irrigation scheme, located in western Turkey	n/a	n/a	0	0	0	0	0	1	n/a	1.7
32	Indonesia	Kelara Karalloe, South Sulawesi	1	n/a	1	n/a	n/a	1	1	1	n/a	10.0
33	Turkey	Lower Seyhan Plain	1	1	n/a	0	0	0	1	0	0	3.8
34	Turkey	Gendiz River Basin	1	1	n/a	0	1	0	1	0	0	5.0
35	Iran	Ravansar Irrigation System	n/a	n/a	n/a	n/a	0	0	n/a	0	n/a	0.0
36	Iran	WUA in Quazvin Province	1	0	0 (The WUAs have received quite old and	1	0	n/a	n/a	0	n/a	3.3

Scheme identification			Outcome related indicators								Impact related indicators	Composite success score
Sr. No.	Country	Name of the scheme	Irrigation service fees and collection rates	Financial viability of WUA	Functional condition of irrigation infrastructure	Equity	Reliability and or adequacy	Popular awareness and support for WUA policies and decisions and for WUA leaders	Frequency of disputes	Crop-related impacts	Livelihoods and household impacts	Normalized success score
					dilapidated canals, some parts of which are in serious need of rehabilitation)							
37	China	28 Bank WUA Candidate Villages	n/a	n/a	n/a	n/a	1	1	1	0	0	6.0
38	China	15 Non-Bank WUA Candidate Villages (villages in the WB survey sites which have adopted WUAs by 2005, but which were not directly affiliated with the WB dsurvey sites.	n/a	n/a	n/a	n/a	n/a	1	1	0	0	5.0
39	Vietnam	Ngoila	0	n/a	n/a	1	0	1	0	1	n/a	5.0
40	Vietnam	N4B	0	n/a	n/a	1	0	0	1	1	n/a	5.0
41	Philippines	Capayas Irrigation System	0	n/a	n/a	0	n/a	0	n/a	0	0	0.0

Scheme identification			Outcome related indicators								Impact related indicators	Composite success score
Sr. No.	Country	Name of the scheme	Irrigation service fees and collection rates	Financial viability of WUA	Functional condition of irrigation infrastructure	Equity	Reliability and or adequacy	Popular awareness and support for WUA policies and decisions and for WUA leaders	Frequency of disputes	Crop-related impacts	Livelihoods and household impacts	Normalized success score
42	Indonesia	water sufficient or WS area of the Tulungagung and Sidoarjo regencies	n/a	Not yet applicable at the time of research	n/a	0	0	1	n/a	0	n/a	2.0
43	Indonesia	water deficit or WD area of the Tulungagung and Sidoarjo regencies	0	n/a	n/a	0	0	n/a	n/a	0	n/a	0.0
44	China	6 WUAs in the Zhanghe prefecture	n/a	n/a	1	0	1	1	1	1	n/a	8.3
45	China	4 WUAs in the Dongfeng prefecture	n/a	n/a	1	0	1	1	1	1	n/a	8.3
46	Philippines	46 IAs in 25 national irrigation systems under the command of the National Irrigation Administration (NIA), over six provinces in the Philippines; Batangas, Cavite, Laguna, Occidental	n/a	n/a	1	n/a	0	0	n/a	0	n/a	2.5

Scheme identification			Outcome related indicators								Impact related indicators	Composite success score
Sr. No.	Country	Name of the scheme	Irrigation service fees and collection rates	Financial viability of WUA	Functional condition of irrigation infrastructure	Equity	Reliability and or adequacy	Popular awareness and support for WUA policies and decisions and for WUA leaders	Frequency of disputes	Crop-related impacts	Livelihoods and household impacts	Normalized success score
		Mindoro, Oriental Mindoro, and Quezon (REGIONAL)										
47	Indonesia	Cipanumbangan irrigation system in West Java	1	n/a	0	0	0	n/a	1	0	0	2.9
48	Indonesia	Cinangka II irrigation system in West Java	1	n/a	1	1	0	0	1	0	0	5.0
49	Indonesia	Kaliduren system in Central Java	n/a	n/a	1	0	1	0	1	1	n/a	6.7
50	Indonesia	Planditan system in Central Java	0	n/a	1	1	1	0	1	0	n/a	5.7
51	Thailand	Khleng Thadi Weir System	n/a	n/a	n/a	0	n/a	0	n/a	0	n/a	0.0
52	Indonesia	Tiroang village (upstream area)	1	n/a	1	0	n/a	1	n/a	1	n/a	8.0

Scheme identification			Outcome related indicators								Impact related indicators	Composite success score
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53	Indonesia	Marawi village (mid-stream area)	1	n/a	1	0	n/a	1	n/a	1	n/a	8.0
54	Indonesia	Pakkie village (lower-stream area)	1	n/a	0	n/a	n/a	1	n/a	0	0	4.0
55	India	Anand District, Gujarat State	n/a	1	1	1	1	1	n/a	1	0	8.6
56	Bangladesh	8 buried pipe irrigation schemes in Tangail	0	n/a	n/a	n/a	0	0	n/a	0	n/a	0.0
57	Philippines	Guimba-Cuyapo Network	n/a	n/a	0	n/a	n/a	n/a	n/a	0	0	0.0
58	Pakistan	Maira Branch Canal	0	n/a	n/a	1	1	1	n/a	1	n/a	8.0
59	Kyrgyzstan	Jalapak	n/a	n/a	n/a	0	0	1	n/a	n/a	n/a	3.3
60	Kyrgyzstan	Jani-Arik	1	n/a	n/a	0	0	1	n/a	n/a	n/a	5.0
61	Kyrgyzstan	Isan	n/a	n/a	n/a	0	0	1	n/a	n/a	n/a	3.3
62	India	Mohini	0	0	n/a	1	n/a	1	n/a	1	n/a	6.0
63	India	Bhima	1	1	n/a	0	1	1	0	1	1	7.5
64	Laos	Ban Vuen Tonhen	0	n/a	0	0	n/a	n/a	0	1	n/a	2.0
65	Cambodia	Tam Lap	1	1	0	1	1	0	n/a	1	1	7.5
66	Cambodia	Banteay Thleay	1	1	1	0	0	n/a	n/a	1	n/a	6.7
67	Cambodia	Kork Kandal	0	0	1	0	0	n/a	n/a	1	n/a	3.3
68	Cambodia	Thoam Ney	0	0	n/a	1	1	0	n/a	0	0	2.9
69	Cambodia	Thnoat Te	1	0	n/a	0	0	1	n/a	1	1	5.7

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70	Cambodia	Phlaurv Touk	1	0	1	1	1	1	n/a	1	n/a	8.6
71	Cambodia	Chan Thnal	1	1	n/a	0	0	1	n/a	0	0	4.3
72	Cambodia	Seventh March	0	0	n/a	0	1	1	n/a	1	1	5.7
73	Cambodia	Tumnub Santesok	0	0	n/a	0	1	n/a	n/a	0	0	1.7
74	Malyasia	Kubang Depu	n/a	1	n/a	n/a	1	n/a	n/a	1	n/a	10.0
75	Sri Lanka	Moraketiya DC	n/a	n/a	1	1	1	1	1	1	1	10.0
76	Sri Lanka	Pubudu WUA in Kaudulla Irrigation System	0	0	0	0	n/a	n/a	n/a	1	n/a	2.0
77	Sri Lanka	Diyawiddagama WUA in Mahaweli System C	0	1	1	0	n/a	0	n/a	0	n/a	3.3
78	Sri Lanka	Nachchaduwa Oya	0	n/a	0	0	0	1	0	0	n/a	1.4
79	Sri Lanka	Hakwatuna Oya	0	n/a	1	0	0	1	0	1	n/a	4.3
80	Sri Lanka	Gal Oya Left Bank Farmers Organization	n/a	n/a	1	1	1	1	1	1	1	10.0
81	Vietnam	La Khe Irrigation System	n/a	n/a	0	0	0	0	0	n/a	n/a	0.0
82	Thailand	Mae Kuang Irrigation System	n/a	n/a	0	0	1	0	0	1	0	2.9
83	Uzbekistan	Akbarabad WUA	0	n/a	1	1	1	1	n/a	1	1	8.6
84	Kyrgyzstan	Kerme-Too Akburasy WUA	0	n/a	0	1	0	0	n/a	0	1	2.9

Scheme identification			Outcome related indicators								Impact related indicators	Composite success score
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85	Tajikistan	Zafarshan WUA	0	n/a	1	1	0	1	n/a	1	1	7.1
86	Philippines	Magat River Integrated Irrigation System	0	n/a	1	1	1	1	1	1	1	8.8
87	Philippines	Oriental Mindoro System	0	n/a	n/a	0	1	0	0	1	n/a	3.3
88	China	Zhanghe Irrigation System	1	1	0	n/a	1	0	n/a	1	n/a	6.7
89	India	XIth Branch Canal Periyar Vaigai Project	1	n/a	0	0	0	1	1	0	1	5.0
90	India	Mettupalayam Distributary in Lower Bhavani Project	0	0	0	n/a	0	0	0	0	n/a	0.0
91	India	Panchanhangipatti Tank	n/a	n/a	0	n/a	0	1	1	0	n/a	4.0
92	Vietnam	WUA B8A	1	0	0	1	1	n/a	n/a	1	n/a	6.7
93	Cambodia	Sopha main canal and station irrigation	n/a	0	1	n/a	1	n/a	n/a	1	1	8.0
94	India	Dusi Mamandur Tank	0	0	n/a	0	0	0	1	0	n/a	1.4
95	India	Hadsi Minor	0	0	0	n/a	1	0	0	1	n/a	2.9

Scheme identification			Outcome related indicators								Impact related indicators	Composite success score
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96	India	Jai Yogeshwar, Ozar, Waghad Project	1	n/a	1	1	0	1	1	1	1	8.8
97	India	Navanad, Mohadi, Waghad Project	n/a	n/a	n/a	1	0	1	0	n/a	n/a	5.0
98	India	Jai Bajrang Project	0	n/a	0	0	0	0	0	0	0	0.0
99	Kazakhstan	Shoymanova	n/a	n/a	0	1	0	0	1	0	n/a	3.3
100	Kazakhstan	Otrar	n/a	n/a	0	1	0	0	1	0	0	2.9
101	Kazakhstan	N. Ilyasov	n/a	n/a	0	1	0	0	1	0	n/a	3.3
102	Kyrgyzstan	Gulbaaar	1	0	0	0	0	0	0	0	n/a	1.3
103	Uzbekistan	Pakhtaabad	0	0	1	1	1	0	1	1	n/a	6.3
104	Uzbekistan	Dostlik	0	0	1	0	0	0	0	0	n/a	1.3
105	Uzbekistan	Kirrkiz	0	0	0	0	0	0	0	0	n/a	0.0
106	Thailand	IWUG 18R canal	0	n/a	n/a	1	0	0	0	0	n/a	1.7
107	Thailand	IWUG SHUAI	1	1	n/a	1	1	1	n/a	1	n/a	10.0
108	Thailand	WUA Ban Rom	0	0	n/a	1	1	n/a	0	0	n/a	3.3