

Pro-poor Intervention Strategies in Irrigated Agriculture in Asia

Poverty in Irrigated Agriculture:
Issues, Lessons, Options and Guidelines

Bangladesh, China, India, Indonesia, Pakistan and Vietnam



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Final Synthesis Report

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Foreword

Acknowledgements

This is the final synthesis report for the ADB-financed research project on “Pro-poor intervention strategies in irrigated agriculture in Asia.” The project was implemented by the International Water Management Institute (IWMI) in collaboration with key national partners in six countries: India, Pakistan, Bangladesh, China, Indonesia and Vietnam. The synthesis presented in this report is based on the background papers prepared after the final regional workshop held on 25-27 August 2004, with additional analyses, review of additional literature and further syntheses of study outputs produced over the past 4 years including the study summary report, country study reports and papers presented at national and regional workshops. The report also incorporates comments and suggestions made by the stakeholders, including those from ADB reviewers and representatives, during the second regional workshop. Cooperation and dedication of the country study teams for successful implementation of the study are highly appreciated. Special thanks are due to Dr. Q.K. Ahmed and Mr. K. Rahman (BUP-Bangladesh); Drs. Jikun Huang and Jinxia Wang (CCAP-China); Drs. Chris Scott and M. V. K. Sivamohan (IWMI-India); Drs. Sigit Arif and Mochammad Maksum (CRRD-UGM, Indonesia); Drs. Waqar A. Jehangir and Mohammad Ashfaq (IWMI-Pakistan); and Drs. Eric Biltonen and Doan Doan Tuan (CIWSR, Vietnam). Thanks are also due to other study team members in each country. Financial support from the ADB for the study is gratefully acknowledged. Valuable comments and suggestions from the ADB during the early phase of the study and during the final regional workshop, particularly from Messrs. Wouter Lincklean Arriens, Kenichi Yokoyama, Toru Shibuchi, and Bert van Ommen are highly appreciated. Special thanks to Prof. Michael Lipton and Prof. John Soussan for their useful comments and suggestions.

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This report is dedicated to our team member late Dr. Waqar Ahmad Jehangir who very ably led the Pakistan component of the study.

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Executive Summary

There is no doubt that the Green Revolution transformed the lives and livelihoods of millions of Asia's people. Between 1970 and 2000, annual cereal production in the region more than doubled to nearly 800 million tons, with most countries achieving self-sufficiency in staple food grains. The threat of famine, never far away during the 1960s, receded over a period when the region's human population increased by roughly 60 percent. Rural incomes rose, city food prices fell—and the economy prospered. But the rest is decidedly *not* history. Despite the achievements of the Green Revolution, poverty persists in Asia, which today contains the highest absolute numbers of poor—more poor people even than in sub-Saharan Africa. Poverty is particularly deeply entrenched in South Asia, which is home to 44 percent of the world's poor.

The Green Revolution in Asia could not have happened without massive flows of water—irrigation water—to bring the best out of the new crop varieties and other inputs that were also made available to farmers. Nor would it have been possible without massive flows of investment capital to build new irrigation schemes and expand existing ones as well as to fund the provision of other infrastructure and services to rural areas, including research and extension. Today, the use of both surface water and groundwater remains essential to Asian agriculture: 40 percent of the region's cropland is irrigated. Hundreds of millions of rural people across the continent depend on irrigation—including large and medium-scale canal systems—to earn a living from farming.

Irrigation, then, is an essential part of the package of technologies, institutions and policies that underpins increased agricultural output in Asia. Past experience shows that this package, although broadly beneficial to society, has not yet fully succeeded in banishing poverty. So, in the context of the UN millennium goal of halving world poverty by the year 2015, are there ways of making the package more pro-poor in the future?

In 2001, IWMI, in collaboration with national partners, launched a major study that set out to answer this question. Funded by the Asian Development Bank

(ADB), the study explored the links between irrigation and poverty alleviation in six Asian countries. The objective was to determine realistic options for increasing returns to poor farmers in the low-productivity irrigated areas within the context of improving the overall performance and sustainability of the established irrigation schemes. The study examined the evidence regarding the effects of irrigation—and particularly its interaction with other components of the package—as a basis for drawing out lessons for policymakers, donor agencies and researchers.

The six countries included in the study were deliberately selected to encompass different policy, social and economic settings. Three countries in rapidly growing but inequitable South Asia—India, Pakistan and Bangladesh—formed a contrast with two in East and Southeast Asia—China and Vietnam—where economic development has proceeded more fairly and with a third, Indonesia, in which irrigation development has been part of a large government-funded transmigration scheme. China, in particular, is a case in which irrigation and agriculture have developed in the context of a long-term national program to eradicate poverty. The six countries also present contrasting models of the transfer of irrigation management from public agencies to farmer groups or private hands.



The study, which is based on primary data and a review of global literature covering more than 200 studies, was the most thorough of its kind ever carried out. Over 5,400 households in 26 irrigation systems took part in surveys during 2001 and 2002. The 227 professionals who worked on the study interviewed a cross section of irrigation stakeholders, from farmers to local and national policymakers and practitioners. Fourteen workshops with over 800 participants were held to plan the research and discuss its findings. By virtue of its scope, its widely applicable results and the strength of its multidisciplinary approach, the study provides a model for the design of future pro-poor projects.

This report provides an internally reviewed final synthesis of the study findings, conclusions and lessons learnt, and outlines the identified pro-poor intervention options and guidelines. The report is only one of a series of both published and unpublished papers and reports produced under the study including papers published in international journals, a special issue of *Water Policy*, papers presented at the Third World Water Forum and subsequently published in ADB water poverty series, IWMI working papers, papers published in proceedings of the national and regional workshops, and other unpublished papers and reports. A synthesis of lessons and proposed interventions and actions for each of the six countries is presented in separate country-specific synthesis reports and also in the appendix of this report.

The report provides a generic framework for understanding and designing pro-poor interventions in irrigated agriculture covering a wide range of issues including benefits and dis-benefits (adverse impacts or externality costs) of irrigation, irrigation-poverty linkages, factors influencing performance of irrigated systems and their poverty linkages, irrigation management reforms, irrigation service charging for improved cost recovery, irrigation application and resource conserving technologies—and their implications for the poor. From the study findings and conclusions, the following broad lessons are identified for the consideration of government policymakers, representatives of donor and

development agencies, and others charged with reducing poverty in irrigated agriculture.

Irrigation reduces poverty across all study systems. One of the main conclusions of the study is that irrigation does indeed significantly reduce poverty as measured by household income. Poverty outside of irrigation systems in nearby nonirrigated settings is much higher (almost twice) than that within irrigation systems. However, poverty is still high in irrigation systems, averaging 34 percent. There are significant inter- and intra-country differences in poverty incidence in irrigation systems. Poverty is much higher in South Asian systems (particularly in Pakistani systems) than in Southeast Asian and Chinese systems. Inter-system differences in poverty are also much higher in the former than in the latter systems.

Indirect benefits of irrigation at the local and broader economy level can be much larger than the direct crop productivity benefits of irrigation. Canal irrigation generates a variety of direct and indirect benefits at the local and broader levels (increased crop productivity, employment, wages, household incomes and expenditures, increased food supplies/food security/food affordability due to lower prices, increased induced investments in agricultural and non-agricultural sectors, groundwater development and recharge), but the benefits vary greatly across settings. The indirect benefits of irrigation at the local and broader levels, including multiplier benefits, can be much larger than the direct local-level productivity benefits. Further, medium- and large-scale canal irrigation systems attract private-sector investments in irrigated agriculture, including in groundwater irrigation, and other related sectors. These benefits can help reduce poverty.

Irrigation reduces more poverty under certain conditions. The pro-poor impact of irrigation differs significantly from one setting to another. The extent of benefits to the poor depends on factors such as land and water distribution, the quality of irrigation and infrastructural management, the availability of inputs and support services, and water and agricultural policies. Irrigation can also be anti-poor in situations where adverse social, health and environmental dis-



benefits/costs of irrigation outweigh the benefits the poor receive from irrigation. These anti-poor outcomes of irrigation reflect failure of policy, planning and management and can be avoided or minimized through effective interventions. Irrigation investments, whether in new development or in the improvement of existing systems, should not always be assumed to reduce poverty in a significant way. In fact, irrigation can be *strongly pro-poor, neutral or even anti-poor* depending on the above factors. In South Asia, several influencing factors, notably land equity and irrigation governance and management arrangements, have been unfavorable. So, despite large investments in infrastructure and related inputs and services, the poverty-related impact of irrigation in that subregion has been mixed—and certainly not as good as in China and Vietnam. Overall, South Asia has only partially benefited, in terms of realizing poverty-reducing impacts of past irrigation investments, and there are significant opportunities for increasing benefits of irrigation to the poor.

Apart from irrigation, land, roads and education are important for poverty reduction. Evidence from our extensive review of recent studies suggests that no single intervention is sufficient for effective poverty alleviation. Irrigation is one of the important interventions for poverty alleviation along with land, education and roads infrastructure. Poverty-reducing impacts of irrigation are large when these and other complementary elements such as market systems are in place.

There is more poverty in some areas and among some social groups than in others. Despite the overall poverty-reducing nature of irrigation, income poverty persists in most irrigation systems, particularly in South Asia. Poverty levels are highest in marginal areas,

downstream sites (the “tail”), and areas where canal water is in short supply and the quality of groundwater is poor. In South Asian systems studied, poverty is generally higher at downstream/tail reaches, particularly in areas where access to canal water is least, groundwater is of poor quality and alternative sources of livelihoods are more limited. In these systems, poverty is lower at the middle reaches than at the tail reaches. However, in Chinese and Vietnamese systems, head-tail differences in poverty are not as pronounced as in South Asian systems. In the latter systems, poverty tends to afflict the agriculture-dependent landless, female-headed households, as well as households whose farms have low productivity. Income poverty, which may be either chronic or seasonal, tends to be high in areas where irrigation systems perform poorly. These findings suggest that there is scope for targeting support to the poor in South Asian systems.

Equity and security in access and rights to resources matter for larger poverty impacts. Inequity and insecurity in access and rights to land and water are bad for both productivity and poverty. Where land and water equity exists, irrigation in itself is pro-poor (as in Chinese and Vietnamese systems).

As much as there is gender discrimination, there is also discrimination of minorities and groups along caste and ethnic lines in irrigation. There are strong linkages between irrigation, gender, diversity and poverty issues. In South Asian systems, poverty is generally higher among female-headed and low-caste/ethnic minority households. From a socioeconomic standpoint, they are important stakeholders. However, their participation in irrigation management is very low. Their involvement in irrigation decision making is important not only to address existing gender and diversity discrimination issues, but also to enhance benefits of irrigation investment to the poor men and women. The improved understanding of both gender and diversity issues is important for designing effective pro-poor interventions.

While irrigation management reforms of recent years in South Asia have generated some benefits, significant benefits to the poor are not visible. In South Asia,

institutional reforms in the irrigation sector are moving at snail's pace and only on a limited scale (e.g., mostly at the tertiary "canal" level but not much at higher levels). In many cases, these changes are proceeding without the prior elimination of basic constraints that have so far prevented poor people from fully enjoying the benefits of earlier irrigation investments. Irrigation reforms will help the poor only if they are carried out as part of a broader set of pro-poor changes—changes that address issues such as fair sharing of resources and higher agricultural productivity and profitability. There are indications, though, that the irrigation-sector reforms where implemented have improved infrastructural maintenance, made water distribution fairer, and boosted agricultural production and productivity. However, measurable significant benefits to the poor are not yet visible. The overall conclusion from the country studies is that while the ongoing reforms being promoted, particularly in South Asia, such as irrigation management transfer and participatory irrigation management, have generated some benefits

including for the poor, they have been implemented only partially, with no explicit pro-poor elements, and are not sufficient for improving system performance and benefits to the poor in a significant way.

In South Asia, unless irrigation reforms are sharpened with a pro-poor focus, the poor may be bypassed. Irrigation reforms are likely to generate significant benefits for the poor where land and water are less inequitably distributed; users are socioeconomically less heterogeneous; benefits of irrigation to farmers are significant and irrigated agriculture is profitable; there are accountability mechanisms and incentives in place for improving service delivery; cost of irrigation to users is linked to service delivery; and irrigation performance is linked not only to broader-level growth benefits but also to benefits to the poor. In South Asian countries, where most of these conditions are only partially met, unless irrigation reforms are sharpened with a clear pro-poor focus through necessary changes in policies and institutions, the poor are likely to be bypassed, as in the past.



Some of the Key Messages

- It is generally perceived that there is a trade-off between equity/poverty and productivity. This study suggests that this is not necessarily so. High level of inequities in land and water are bad for both productivity and poverty. Irrigation has larger poverty reducing impacts where land and water are more equitably distributed.
- Irrigation benefits are often seen mainly in terms of crop productivity improvements. However, the study suggests that crop productivity is only one of many direct and indirect benefits of irrigation (such as benefits related to employment, wages, prices, consumption, food security, incomes, benefits from multiple uses of water, irrigation induced investments in agricultural and nonagricultural sectors, benefits from canal-water-induced groundwater development and recharge) classified as type 1-5 in this study. Indirect benefits of irrigation can be larger than direct benefits when these other benefits are also accounted for.
- It is often assumed that targeting of poverty and support to the poor in canal systems is difficult. The study findings suggest that poverty varies significantly across systems and locations within systems, particularly in South Asian systems, and geographical targeting of poverty across and within systems can be done.
- Low irrigation service charge policy is often justified on account of poverty and is assumed to benefit the poor. The study suggests that in settings with greater inequities in land and water distribution, as in India, Pakistan and Bangladesh, low level of irrigation charge does not necessarily benefit the poor, and it could be disadvantageous to the poor where low charges lead to under-spending on O&M works and the system performance suffers. Further, application of a single level of irrigation service charge across areas and systems could lead to situations where the poor end up subsidizing the non-poor.

The study suggests that:

- Irrigation interventions can be designed to redistribute benefits in favor of the poor.
- For irrigation investments to be pro-poor, the criteria should be not only hectares developed/rehabilitated, but also the number of households/farms/persons benefited; and not only the aggregate productivity benefits but also the various types of benefits and the share of the poor in total benefits.
- In making new investments (either in new development or improvements of existing systems) and in designing irrigation interventions and irrigation impact assessments/evaluations, it is important to incorporate a) poverty alleviation criteria as defined in this study (i.e., strongly pro-poor, pro-poor, neutral or anti-poor), b) generic typology of direct and indirect benefits and dis-benefits (type 1 to 5), c) typology of beneficiaries/affectees, and d) a tri-level framework (micro, meso and macro levels) for identifying constraints and opportunities for enhancing benefits of investments/interventions to the poor.

In addition to offering a comprehensive framework for identifying and designing pro-poor interventions, the study provides a menu of pro-poor intervention options and a detailed set of specific actions and guidelines.

Effective institutions for management, incentives to managers and service providers, decentralized financing, and effective arrangements for monitoring and accountability matter for irrigation performance.

Irrigation systems managed by public agencies tend to perform poorly. The underlying causes are inadequate funding, lack of incentives for good management, and weak monitoring and accountability mechanisms. Further, lack of clear and secure water rights and allocation rules and corruption-related problems adversely affect performance of irrigation systems and their poverty-reducing impacts. On the financial side, irrigation charges to users in South Asia are often too low or improperly structured, collection costs are too high, and the fees collected from users are not actually channeled back into local system operations and maintenance. Moreover, the low level of irrigation service charges applied uniformly to all socioeconomic groups of farmers often disadvantage the poor, particularly in systems characterized by high inequity in land and water distribution. There are indications, though, that performance is improving in irrigation systems where management functions have been transferred to local user groups and private service providers.

Benefits and costs to the poor, and long-term sustainability of irrigation software and hardware should matter in the calculus of irrigation investments.

Irrigation investments have typically centered on the creation of physical facilities and institutions and on their economic performance in terms of aggregate costs and benefits, with little or no attention to specific benefits and costs to the poor. In most situations in South Asia, almost no attention has been paid to the longer-term sustainability of the new infrastructure and organizations created, and to enhancing their benefits to the poor on a long-term basis.

Larger poverty impacts can be realized by integrating investments in irrigation infrastructure, management and service delivery.

Evidence from both other recent studies and ours shows that the poverty-reducing impacts of irrigation-related interventions are larger when they are implemented in an integrated framework (e.g., integrated approaches for—

managing surface water and groundwater; developing systems that allow multiple uses of irrigation water, and for new investments in improving irrigation infrastructure, irrigation management, and service provision in agriculture (provision of inputs, technologies, information, finance, marketing)).

Chinese experiences in resource distribution, institutional, management and technological interventions offer important learning opportunities for South Asia.

As a whole, South Asia has much to learn from experiences in land and water distribution, institutional, management and technological interventions, in Southeast and East Asia, particularly China. In these latter regions, irrigation management and other support services are more incentive-based and relatively more equitable, and the agriculture productivity and the benefits of irrigation are higher as a result. China and Vietnam have adopted a “distribute first” approach to land and irrigation water, and rural development as a whole. South Asia, in contrast, has adopted a “grow first” policy in which distributional issues have largely been ignored. As a result, irrigation has not benefited the poor people nearly as much as it could have in this subregion. In the South Asian countries studied, there is a considerable scope for reducing poverty through land, water, productivity and related policy- and management-level interventions.

Based on these conclusions and lessons, the study develops a range of options, detailed specific measures and a set of guidelines for addressing the identified key issues and for moving forward with pro-poor interventions. In India, Pakistan and Bangladesh, the first and the basic step is to create an enabling environment for correcting existing resource inequities for poverty reduction—through development and strengthening of policies, laws and strategies (specifically related to poverty reduction, land, agriculture and the water sector) and linking these policies under a consistent framework. This should aim at creating permanent assets for the poor by developing and strengthening of land and water rights in a pro-poor mode (as proposed in this report). The following are some of the key suggestions for making

irrigation investments in new development or improvement/rehabilitation of existing systems pro-poor. Unless specified, these are applicable to all countries studied. The proposed country-specific interventions and actions are presented in the individual country-specific synthesis reports and summarized in the appendix of this report.

Make irrigation investments pro-poor

- select policy- and project-level interventions based on poverty impacts, including gender and diversity impacts, using a “pro-poor” criterion as suggested in the generic typology of interventions developed in this study (i.e., strongly pro-poor, pro-poor, neutral, anti-poor);
- make poverty impact assessments as the first step in designing, implementing, monitoring and evaluating projects and interventions;
- use the generic typology developed in this study to incorporate all forms of direct and indirect benefits and dis-benefits/costs of irrigation in policy and project development;
- make irrigated agricultural investment packages for hardware and software development more comprehensive by integrating investments in infrastructure, management and service delivery in agriculture, with emphasis on integrated approaches and public-private partnerships;
- prioritize geographical areas and socioeconomic groups for irrigation investments and targeting support to the poor;
- recognize that both gender as well as diversity aspects are critical not only to addressing inequity and discrimination issues but also to enhancing benefits of irrigation investments especially to the poor.

Redistribute irrigation benefits to the poor through policy and institutional reforms

- adopt a sequenced approach in irrigation reforms using a multi-level framework (micro, meso and macro levels) offered by the study, and prioritize geographical locations for reform interventions with separate models designed according to local conditions.

- in implementing irrigation institutional reforms, distinguish between *irrigation as a “resource”* and as a *“service”*—as the former concept requires some form of public-sector intervention in management of a resource (as it has both positive and negative externalities associated with it), and the latter requires emphasis on delivery of quality services. Adopt pro-poor approaches to managing resource and service delivery with pro-poor institutions, financing and service-delivery arrangements as proposed in the study.
- for addressing difficult issues in land and water equity and rights in South Asian countries studied, start with modest measures as proposed in the study.
- promote other pro-poor measures that lead to redistribution of irrigation benefits to the poor:
 - promote differential irrigation service charging across systems and locations,
 - recover initial capital cost or replacement cost from advantaged areas and large farmers,
 - ensure compensation to the poor smallholders for failure of service providers to deliver water to them,
 - promote labor-intensive methods of construction and rehabilitation of irrigation for increased employment for the poor,
 - promote labor-intensive methods of production in new or rehabilitated systems,



- involve the poor in irrigation O&M activities, monitoring and supervisory roles and in irrigation service charge assessment, collection and spending activities.

Ongoing reforms provide an important entry point for promoting these proposed pro-poor measures, by incorporating them into the new irrigation/water policies and laws, guidelines to irrigation managers and service providers, and in new rules, regulations and laws being established for WUAs and higher canal-level organizations.

- promote decentralized financial autonomy of irrigation service, with an irrigation charging system designed to meet the dual objectives of improved cost recovery and increased benefits to the poor, with a strong regulatory backup. Introduce differential irrigation service charging across locations, and irrigation systems and relate them to system O&M costs, benefits derived from irrigation use and poverty situation—with due attention to aspects such as institutional arrangements, service charge level, charge structure, assessment, collection and spending. The study identifies twelve essential components of charging and offers options for designing a charging system to achieving the desired objectives.

Establish a new institution for monitoring and enhancing benefits to the poor

- make new institutional arrangements for monitoring and enhancing benefits of irrigated agricultural investments to the poor by creating a new body/organization at the national level—establish an independent organization/body for developing, implementing and monitoring pro-poor interventions in irrigated agriculture and for enhancing benefits to

the poor men and women of investments in land and water-resources development especially in India, Pakistan and Bangladesh.

- promote pro-poor approaches to enhancing productivity and the value of water, including diversification of crop and farm enterprises for increased employment opportunities and higher returns to farming; and promote improved production methods, micro-irrigation, and resource conserving technologies.

Develop knowledge-base on poverty and promote learning alliances and partnerships

- strengthen the local-level knowledge base on poverty—the knowledge base on poverty at small geographical scales (such as the subdistrict or irrigation-system level) is weak and sometimes flawed. It needs to be strengthened. Donors, in partnership with national agencies and NGOs, could help create poverty maps and indicators for use at local scales.
- promote adaptive learning and action research. Support and facilitate cross-country exchanges of experiences, knowledge and learning, especially across China and South Asian countries.
- facilitate development of partnerships among public agencies, the private sector, NGOs and poor communities for improving access of the poor to resources and service delivery in agriculture.

We trust that the study lessons and the proposed pro-poor intervention options and guidelines offered in the report would be useful to the government policymakers and planners, donors, NGOs, researchers and other stakeholders involved in poverty-alleviation efforts in developing Asia and elsewhere.

Poverty is humiliation, the sense of being dependent, and of being forced to accept rudeness, insults, and indifference when we seek help.
(Voices of the Poor, Deepa Narayan, Robert Chambers, Meera Kaul Shah and Patti Petesch 2000).

1. Objectives, Scope and Approach

The “Pro-poor intervention strategies in irrigated agriculture in Asia” is the ADB- financed study under its “RETA No. 5945–Fifth Agriculture and Natural Resources Research at CGIAR Centers dated 8 February 2001” implemented by the International Water Management Institute (IWMI) in collaboration with key national partners in six Developing Member Countries (DMCs) of the ADB: India, Pakistan,

Bangladesh, China, Indonesia and Vietnam. The study was carried out in selected 26 medium and large-scale canal irrigation systems, including some financed by the ADB, in participating countries. The study focused on identifying and assessing a set of appropriate interventions at field and system levels, and changes in overall policy and institutional framework as far as they affect access to water resources for the poor.

Box 1: What does the report offer?

This report provides an internally reviewed final synthesis of the study findings, conclusions and lessons learnt, and outlines the identified pro-poor intervention options and guidelines. This is based on a synthesis of lessons derived from a series of both country-specific and cross-country outputs produced under the study including detailed country reports for each of the six countries, a report summarizing all country study reports, various papers and proceedings of the national and regional level workshops, and the issue papers developed after the second regional workshop held in Colombo in August 2004 (for addressing and incorporating comments and issues raised by stakeholders including those from the ADB), and an extensive review of directly or indirectly related global literature covering more than 200 studies. While this report covers some of the key country-specific lessons and interventions, a synthesis of lessons and proposed interventions and actions for each of the six countries are presented in separate country-specific synthesis reports/briefs and summarized in the appendix of this report.

This report is only one of a series of both published and unpublished papers and reports produced under the study including papers published in international journals, a special issue of *Water Policy*, papers presented at the Third World Water Forum and subsequently published in ADB water-poverty series, IWMI working papers, papers published in proceedings of 14 national and regional workshops held for the study, and other unpublished papers and reports (see table in last section for details).

The report provides a generic framework for designing interventions in irrigated agriculture and addresses a wide range of issues including benefits and dis-benefits of irrigation; irrigation and poverty linkages; factors influencing performance of irrigated systems and their poverty linkages; irrigation management reforms, irrigation service charging for improved cost recovery, irrigation application and resource conserving technologies—and their implications for the poor. This is followed by an outline of key lessons learnt, and pro-poor intervention options and guidelines. Considering the interest of stakeholders including ADB, some of the issues that were beyond the original TOR of the study were also covered with additional work and reviews of the available information and data in order to make the study as comprehensive as possible in the given time frame. These include issues related to the broader economy-wide indirect benefits of irrigation, small-scale versus large-scale irrigation, groundwater versus canal water irrigation, poverty impacts of irrigation versus other development interventions, and gender, diversity and corruption issues in irrigation. While the study examined these issues with available material, some of the aspects that could not be dealt with in depth are highlighted in the last section on issues for further research.

1.1 Goal and objectives

The overall goal of the study is to promote and catalyze equitable economic growth in rural areas through pro-poor interventions in irrigated agriculture in the participating countries. The immediate objective is to determine realistic options for increasing returns to poor farmers in the low-productivity irrigated areas within the context of improving the overall performance and sustainability of the established irrigation systems. The study focuses on selected representative irrigation systems and their peripheries with a large number of people under persistent poverty in the participating DMCs. For manageability of research, the study was divided into four main components: a) assessment of poverty and impacts of irrigation on poverty—*analysis of irrigation-poverty linkages*, b) assessment of irrigation system performance and its linkages with poverty—*diagnosis of causes of existing problems related to irrigation performance and their implications for the poor*, c) assessment of recent interventions under institutional reforms in irrigation and their implications for the poor—*drawing and synthesizing lessons from interventions and innovations*, and d) synthesis of findings and development of intervention options and guidelines.

1.2 The study settings, approach and data

The study was carried out in selected representative medium and large-scale canal irrigation systems and their peripheries. The study selected 26 canal irrigation systems with diverse characteristics that, put together, are to a great extent representative of canal irrigation systems in the region. The selected systems vary in terms of size from 813 hectares to as large as 508,000 hectares, canal water availability and groundwater use, conjunctive use of surface water and groundwater, rainfall (ranging from 200 mm to over 1,500 mm), crop productivity, cropping patterns and level of crop diversification from mono cropping to highly

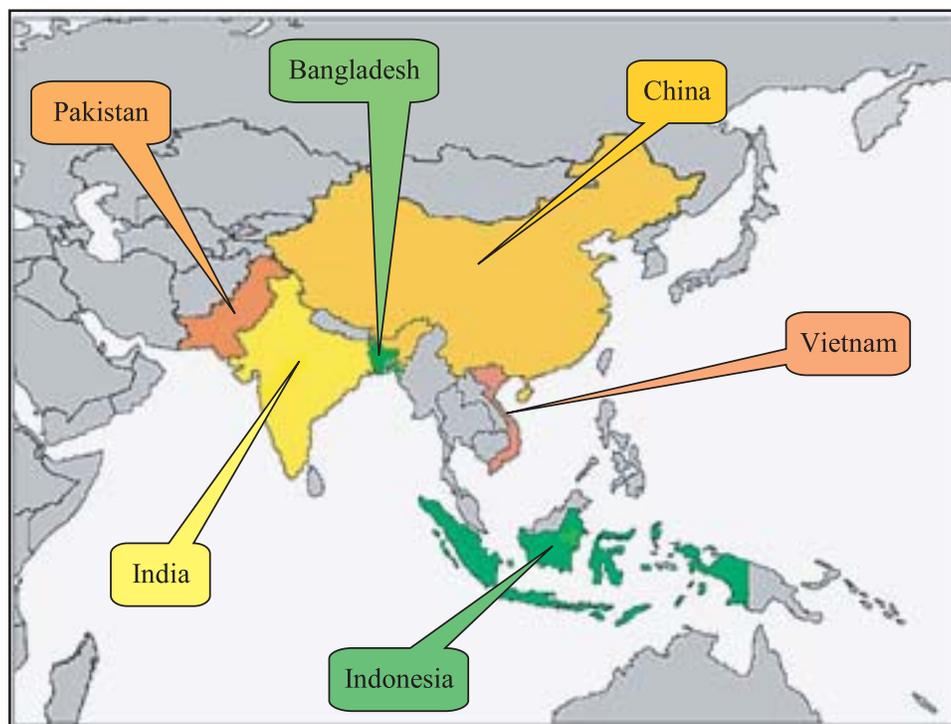
diversified cropping patterns, irrigation infrastructural condition and its maintenance, irrigation management patterns (agency management, participatory management, transferred systems), land quality, size of household landholdings and other similar characteristics.¹

The study used both secondary data and field-level primary data and information, and employed both qualitative and quantitative approaches to analyses. The secondary data were obtained from a variety of sources including government publications, donor reports, and other published and unpublished sources. In addition, an extensive review of national and international literature was conducted as an important part of this study. The primary data collected from the field also provided an important source for examining issues in the study. IWMI, in collaboration with national partners, employed a variety of tools for primary data and information collection, such as field-level focus-group discussions, participatory rapid appraisals and a *structured* questionnaire for household-level surveys. For household-level surveys, consistent procedures were adopted for developing a sampling framework and for sample selection across selected systems in the six countries.

For each irrigation system, samples were drawn using multistage stratified, cluster and random sampling methods. The total survey sample size was 5,408 households in the 26 selected systems. The survey covered cropping seasons during the 2001-2002 agricultural year. In estimating poverty, the study used a range of both monetary and nonmonetary indicators. The monetary indicators of poverty were estimated using income poverty lines that approximate the international poverty line of a dollar a day in purchasing power parity terms. Further, for comparing performance of irrigation systems, standardized measures were used (e.g., crop productivity across system was measured in standardized value of output). As there is no single method, indicator or model to examine and analyze such a wide range of issues

¹ See appendix for detailed characteristics of the selected systems.

Figure 1: Map showing the study locations.



covered in the study, a number of methods, techniques and tools, ranging from simple indicators to fairly complex analytical methods were employed in assessing impacts, diagnosing problems and analyzing various issues. While, in consultation and agreement with the ADB, the country teams were given more flexibility as they desired in the selection and application of methods proposed in the study work plan, every effort was made to ensure consistency in approaches across countries.

1.3 The context—water and poverty in the study countries

Agriculture in developing Asia as a whole has made remarkable progress over the past three decades. Between 1970 and 2000, annual cereal production in the region more than doubled to nearly 800 million tons, with most countries achieving self-sufficiency in the staple food grains. This remarkable growth in food production was largely attributed to growth in irrigated agriculture, coupled with the use of high-

yielding varieties of crops and the application of fertilizers and pesticides. The study-participating countries are among the top few countries where substantial investments have been made in the development of large- and medium-scale canal irrigation systems, and where irrigated agriculture provides livelihoods to hundreds of millions of rural people. These countries together account for over 51 percent of the global net irrigated area and over 73 percent of the net irrigated area in Asia, with most of this area located in China, India and Pakistan.

However, agricultural development and poverty-alleviation performance have varied greatly in these countries over the past three decades. While Southeast Asia and China have lifted a large proportion of their population out of poverty, South Asia continues to be home to the largest number of the world's poor, estimated at 44 percent of all the poor on the globe. Among the participating six countries of the study, poverty is lowest in China and highest in Bangladesh and Pakistan. China has made remarkable progress in reducing poverty since the late 1970s. From 1978 to 2000,

more than 200 million rural poor have been lifted out of poverty, with poverty incidence in 2000 estimated at 3.4 percent in rural areas and less than 2 percent in urban areas, and poverty continues to decline in the country. Such a large reduction in poverty is generally attributed to greater equity in resource distribution (such as land), and broad-based economic reforms, which included the adoption of a production responsibility system, dismantling of the commune system, agricultural product price adjustments and market liberalization, resulting in dramatic rural growth. Likewise, rural infrastructural investments, including investments in irrigation, have significantly contributed to growth and poverty alleviation. The agriculture sector, which showed an impressive performance, was at the forefront of reforms. Vietnam also has an impressive record of combating poverty. The estimates for Vietnam show that the incidence of poverty fell from 58 percent to 37 percent between 1993 and 1998, largely attributed to recent *doi moi* reforms. In 1997, the economies of almost all Southeast Asian countries, including Indonesia and Vietnam were adversely affected by the Asian-financial crises. In Indonesia, for example, poverty increased from 11 percent in 1996 to 20 percent in 1999. However, since then, poverty appears to have declined considerably, though it is still substantially higher than in the precrisis period. These countries are now getting back on track.

Bangladesh has made good progress over the past decade despite the worst of floods. However, over one-third of the country's population continues to suffer in deep poverty, which remains one of the serious socioeconomic problems in the country. While estimates vary, around one-third of the population in India continues to live under poverty. The large population of over one billion, along with historically high inequities in resource distribution, continuing deprivations of education and basic health, gender issues, and class and caste inequities are some of the underlying factors. In Pakistan, the poverty situation has worsened during the second half of the 1990s, and the estimates suggest that more than 12 million people were added to the poor in Pakistan between 1993 and 1999. The rising poverty in Pakistan was the result of poor governance and slow

economic growth. The rural economy of the country has been caught up in a vicious circle of problems, a rapidly increasing population resulting in a decreasing per capita resource base, low literacy levels, continuing high level of inequity in resource distribution, slow growth in both farm and nonfarm sectors, and more importantly, continuing poor governance—all these factors adversely affected the efforts to reduce poverty. The agricultural economy, which forms the backbone of the broader rural economy of the country has been facing problems of increased water scarcity, degradation of land and water resources, and continuing low levels of agricultural productivity. Effectiveness and overall impacts of new poverty alleviation initiatives started in 2001 are yet to be seen.

Attempts made by the countries, especially in South Asia, to improve the productivity of the irrigated areas by addressing the constraints specifically have been minimal and largely ineffective. There has been a lack of proactive policies, effective institutions and actions to this end. Additionally, previous irrigation-related research studies focused mainly on general agricultural productivity increases under the overall goal of enhancing food security mainly at the national level with little attention to poverty alleviation. This study attempts to fill the existing gap in knowledge for developing effective pro-poor interventions in irrigated agriculture.



2. A Framework for Understanding Irrigation-Poverty Linkages and Designing Pro-poor Interventions

This section provides a generic framework for understanding irrigation-poverty linkages in irrigated agricultural systems and for designing pro-poor interventions. The framework is based on syntheses of lessons learnt from the country studies and extensive review of recent related studies. The key aspects of the framework were examined in detail in the study; some aspects that were beyond the original scope of the study were also covered, largely based on reviews of available secondary information and other recent studies; yet there are some aspects that need further research and these are highlighted in the last section. The framework offers a comprehensive approach for effectively addressing poverty issues in irrigated agriculture.

2.1 Understanding the concept “pro-poor”

The term “pro-poor” intervention or approach has been defined and described variously by development experts and organizations, and there is no agreed definition or clear consensus regarding its precise meaning. However, the following three aspects are emphasized for an approach or intervention to qualify as “pro-poor:”

- a) when benefits to the poor are immediate, significant, greater than their current benefits, and greater than the average level of benefits to the society as a whole; and to the nonpoor, overall socioeconomic indicators of the poor improve faster than those of the nonpoor;
- b) when policies, institutions, programs and interventions explicitly focus on significantly reducing inequalities in incomes, resources and opportunities, remove institutional and policy-induced biases against the poor, or are deliberately biased in favor of the poor so that the poor benefit disproportionately, create assets for the poor and create an enabling environment for them to participate in economic activities.

Box 2: When is an intervention strongly pro-poor or anti-poor?

An intervention may be regarded as strongly pro-poor, pro-poor, neutral or anti-poor depending on the benefits to the poor as:

- a) *Strongly pro-poor*, where the share of the poor in positive incremental impacts/benefits of an intervention, such as improvements in the key poverty reducing indicators, is significantly greater than their current share and also greater than the share of the nonpoor.
 - b) *Pro-poor*, where the share of the poor in positive incremental impacts/benefits of an intervention, such as improvements in the key poverty reducing indicators, is greater than their current share.
 - c) *Neutral*, where the share of the poor in positive incremental impacts/benefits of an intervention, such as improvements in the key poverty reducing indicators, is equal to their current share.
 - d) *Anti-poor*, where the share of the poor in positive incremental impacts/benefits of an intervention, such as improvements in the key poverty reducing indicators, is less than their current share, or the share of the poor in negative incremental impacts/dis-benefits of an intervention is greater than their current share.
- c) when it involves focusing, favoring and targeting the poor in terms of better utilization of factors of production the poor own (such as labor) in terms of spending and investment in the sectors they work in (such as agriculture), and in areas and localities they live in (poor communities in rural settings) and the outputs which they produce and consume (such as food).

For practical and applied purposes, an intervention in irrigated agriculture—policy, institutional, managerial, legal or regulatory, financial, economic,

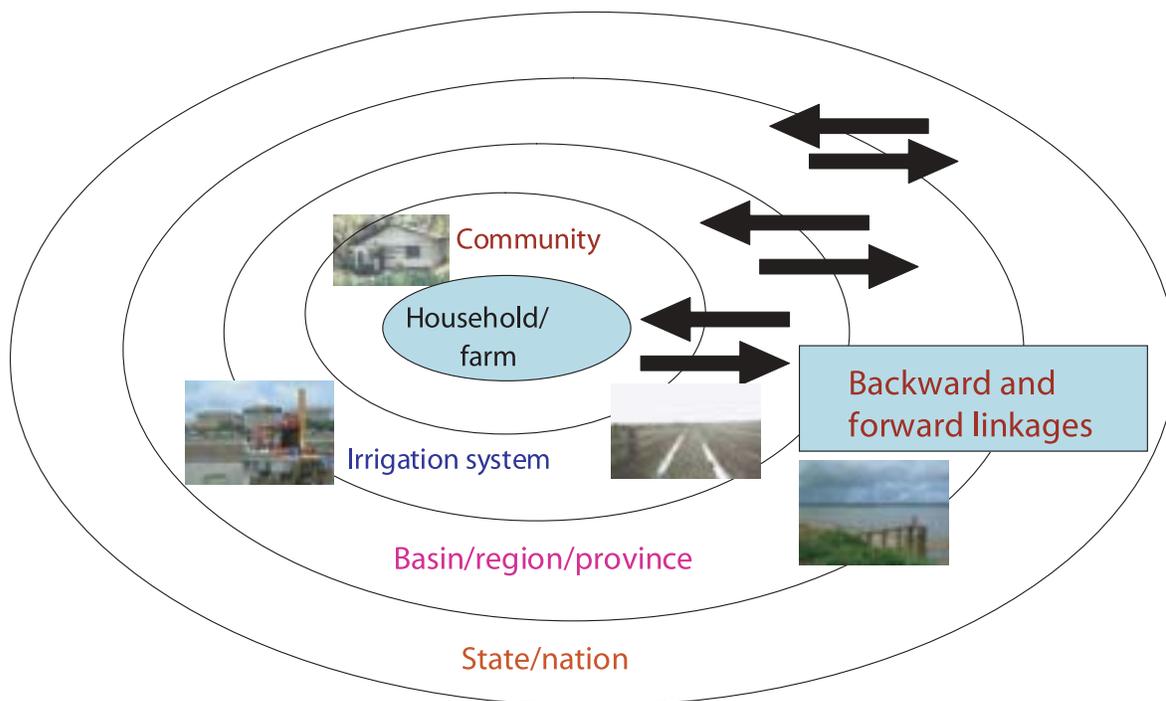
infrastructural or technological—can be regarded as pro-poor if it leads to improvements in agricultural productivity; returns to factors of production such as land and labor; returns to farming; employment and wages; incomes and expenditures and overall livelihoods; and if it generates assets and opportunities for the poor to participate in socioeconomic activities for their welfare, which have significant impacts on poverty reduction. Further, an intervention may be regarded as strongly pro-poor, pro-poor, neutral or anti-poor (box 2).

2.2. Direct and indirect benefits and dis-benefits of irrigation

As a vital resource in agriculture, irrigation generates a variety of benefits contributing to many productive and livelihood opportunities in rural settings. The benefits are generated through several processes, mechanisms and pathways. These include

benefits from irrigation-induced crop intensification and diversification towards high-value crops leading to increased crop productivity and overall crop production; benefits derived through non-crop farm and nonfarm uses of water including nonconsumptive uses of water supplied by irrigation infrastructure; benefits arising from improved employment opportunities and higher wage rates; benefits through improved incomes and consumption expenditures, and enhanced food security; social benefits such as improved health and education; and benefits from expansion in economic activities in related sectors resulting in overall improved growth of regional and national economies. A part of these benefits is realized at the local level, while the other part occurs at the broader regional and national economy levels through what are generally referred to as *backward and forward* linkages of agriculture with other economic sectors (figure 2).

Figure 2: Backward and forward linkages.





The degree and form of these linkages across settings are influenced by a range of factors, such as the extent of rural infrastructural development, rural population density, the degree of local processing of farm produce, the nature of technical change in farming, and tradability of farm outputs. The total benefits of irrigation include direct or primary benefits occurring in local settings, indirect or secondary benefits occurring at the local and broader levels, and induced or tertiary benefits occurring in other sectors at the local and broader levels. The indirect and induced benefits together are generally referred to as *multiplier* benefits.

But all is not good. Irrigation can also lead to social, health and environmental problems. The potential adverse impacts of large-scale irrigation development include displacement of people from new development and construction of irrigation infrastructure, public-health risks from water-related diseases and irrigation-induced land and water degradation. Other potentially negative impacts of irrigation are for example, 1) irrigation-led mechanization of farming (particularly on large farms with increased use of tractors,

combines, threshers, and cotton pickers), which may displace the labor and can have negative effects on employment in the absence of alternative employment opportunities—an anti-poor outcome. This can have potential adverse impacts on the livelihoods of the poor landless and tenants; 2) adverse impacts on the quantity and quality of downstream water resulting from excessive use of water and pollution upstream, affecting livelihoods of downstream water users; 3) loss of biodiversity and altering of the natural environment; and 4) at the broader level, irrigation development can lead to important trade-offs between water needs for the environment and water use for irrigation. Excessive water withdrawals for irrigation could adversely affect health of rivers with adverse impacts on the livelihoods of communities that derive a range of benefits from the river systems. However, many of the potential adverse impacts can be avoided or minimized with effective planning, design and management of the projects.

We develop a generic typology by classifying direct and indirect benefits and dis-benefits of irrigation into five types that can be used to identify and influence different types of irrigation benefits and dis-benefits for enhancing net benefits to the poor (box 3).



Box 3: Typology of irrigation benefits and dis-benefits/costs

The study develops the following generic typology of benefits and dis-benefits/costs of irrigation (see table 2 in the next section for more details)

Type-1: *Direct employment and people (dis)-placement impacts from new development or rehabilitation* - direct benefits and dis-benefits related to employment, placements and displacements of people, land encroachments from development, construction and rehabilitation of irrigation systems.

Type-2: *Direct productivity impacts* - direct benefits and dis-benefits related to productivity-enhancing or -reducing impacts of irrigation.

Type-3: *Local level productivity-induced employment, income, consumption impacts* - localized indirect benefits and dis-benefits related to irrigation-induced impacts on employment, wages, incomes and consumption.

Type-4: *Other indirect impacts* - other localized benefits and dis-benefits related to multiple uses of water, public health, impact on groundwater recharge/pollution.

Type-5: *Broader level impacts*: broader level (multiplier) benefits and dis-benefits of irrigation related to influence on nonagriculture sectors, broader level trade-offs between water for irrigation and for environment at the basin level.

Note 1: one may consider productivity-led changes in employment as direct (dis)-benefits. While acknowledging that these are very important, we have included them as indirect (dis)-benefits more for the sake of consistency and convenience in classification.

Note 2: dis-benefits refer to adverse impacts and negative externalities and associated cost. One may use the term cost or externality cost but we prefer to use the term dis-benefit.

There is a common perception that the benefits of irrigation accrue primarily to landholders, in particular large landholders. While this is true in relation to the most direct productivity-related benefits, a different and more nuanced picture emerges when a broader view of the wide range of irrigation benefits described above is considered. The full range of beneficiaries is shown in box 3. In general, the direct benefits of irrigation in terms of increased agricultural output accrue in proportion to landholdings, with large benefits accruing to large landholders. However, indirect employment benefits accrue primarily to those who sell labor, in particular the landless. Benefits from the multiple uses of irrigation water also likely fall primarily on smallholders and the landless, since most additional uses of irrigation water are of a small or micro-scale nature and are part of the informal water economy upon which low income households depend the most. The distribution of multiplier benefits is more difficult to generalize. Purchasers of food stuffs,

Box 4: Irrigation benefits and dis-benefits are realized by a range of socioeconomic groups

People belonging to various socioeconomic groups realize the benefits and dis-benefits of irrigation through a variety of different mechanisms. These may be classified into five broad groups:

- 1) the landless dependent on the nonagriculture sector;
- 2) the landless dependent on agriculture (i.e., agricultural laborers);
- 3) marginal and small landholders who both farm and sell labor;
- 4) large landholders; and
- 5) other economic agents (e.g., businesses, input suppliers, transporters, agro-industrialists).

in particular the landless, smallholders and urban consumers, clearly benefit from lower prices caused by increased production. The nature of other benefits and beneficiaries may vary substantially by country and region depending, for example, on the nature of rural-urban linkages and degree of development of the nonagricultural economies.

On the other hand, negative social and environmental consequences often adversely affect the poor more than the nonpoor people, as the poor lack political power and financial resources to avoid potential adverse impacts of irrigation whether they relate to displacements, health risks or land degradation.

2.3 Poverty impacts of irrigation

There are two main channels through which irrigation impacts poverty, direct and indirect. The direct channel means that irrigation directly reduces poverty in local settings with various types of direct net benefits (Type 1 and Type 2). The indirect channel implies that irrigation contributes to broader agricultural and economic growth that, in turn, contributes to overall poverty reduction. The transmission mechanisms for poverty-reducing impacts of irrigation can be described through the following interlinked pathways:

- *Micro-pathway*: through increasing returns to physical, human and social capital of the poor households (productivity and employment pathway);
- *Meso-pathway*: through integrating the poor into factor-product and knowledge/information markets (market participation pathway); and
- *Macro-pathway*: through improving national growth rates and creating second-generation positive externalities (economic growth pathway).

Further, poverty outcomes depend on how systems perform. There is a range of factors that can influence system performance that, in turn, affects the magnitude of antipoverty impacts of irrigation. Based

on the review of recent studies, our country study findings, and analysis and synthesis of lessons from the country studies, we classify factors influencing irrigated system performance and poverty into three broad categories as: micro/local, meso/intermediate and macro/national level factors (box 5).

The linkages across these three levels and related factors are shown in figure 3, presenting a tri-level framework. In this framework, poverty reduction impacts of irrigated agriculture performance depend on changes in key poverty determinants such as investments in irrigation/agriculture and other related sectors, production, employment and wages, incomes, assets and other poverty-reducing indicators. These determinants tend to be interrelated and reinforce the impacts of each other. The degree of their impacts depends on: a) magnitude of benefits and costs; b) distribution of benefits and costs among the poor and

Box 5: Understanding factors influencing irrigation-poverty performance

We classify factors influencing irrigated agricultural system performance and poverty impacts into three broad categories:

- (i) *micro/local level—underlying structural factors* (such as land tenure systems, structure of land distribution, water distribution practices, cultivation methods, cropping patterns, community/household attributes, etc.);
- (ii) *intermediate/meso level—institutional/management factors* (such as system level irrigation management institutions, infrastructural management, O&M of systems, production-market linkages at the regional level); and
- (iii) *higher macro level—contextual factors* (such as investment policy, land policy, input subsidy/tax policy, price support policy).

nonpoor men and women; and c) a set of constraints and opportunities therein. These parameters are influenced by a number of factors at micro, meso and macro levels. These three levels are linked to each other.

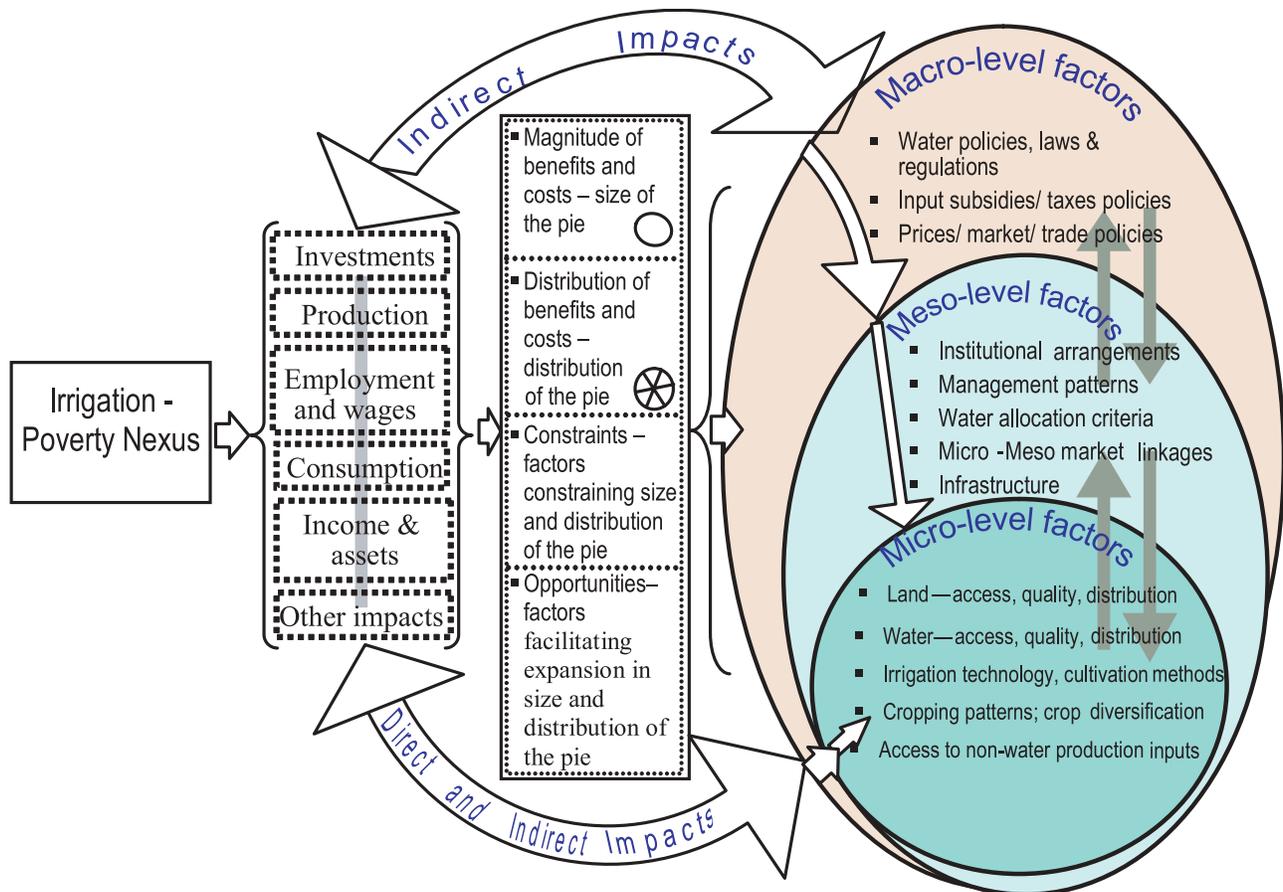
The set of constraints and opportunities at these three levels ultimately determines the magnitude of net impacts of irrigation performance on poverty. For example, if the underlying local-level structural factors are not favorable (e.g., high inequities in land distribution), improvements in contextual factors at the macro level or management factors at the intermediate level may not generate desired results. Similarly, if the macro level contextual

factors are not favorable, the impacts of any corrective measures on structural factors at the local level may be only limited.

2.4 Identifying and designing interventions

The above analysis can help guide for identifying key constraints and opportunities and for designing pro-poor interventions, including needed policy changes, at various levels. The guidelines, based on key questions and main steps, for identifying and designing pro-poor interventions are summarized in box 6.

Figure 3: Irrigation-poverty alleviation linkages.



Box 6: Key questions and steps in identifying and designing pro-poor interventions

The following are some of the proposed key questions and steps in identifying and designing pro-poor interventions in irrigated agricultural systems.

- 1) What is the magnitude of poverty, what are its causes, and what are the characteristics of the poor?
- 2) What is the distribution structure of land and water resources in a given system (and associated rights and allocation rules and practices at the broader and local levels)?
- 3) What is the magnitude of direct and indirect net benefits of irrigation (Types 1 to 5)?
- 4) What is the share of the poor in net benefits of irrigation? (see appendix for indicators)?
- 5) What are the constraints and opportunities at various levels (micro, meso and macro) for enhancing benefits and reducing dis-benefits to the poor?
- 6) What are the realistic pro-poor intervention options for improving performance and sustainability of irrigated agricultural systems, in relation to:
 - a. Physical infrastructural performance
 - b. Institutional/management/organizational performance
 - c. Technological performance
 - d. Gender performance
 - e. Financial, cost-recovery performance
 - f. Land- and water-rights security performance
 - g. Irrigation water allocation/distribution performance (i.e., upstream-downstream)
 - h. Quality of irrigation-service-related performance
 - i. Environmental and sustainability performance
- 7) What are the key indicators for measuring performance of the above aspects, and what are the data needs?
- 8) How can the identified interventions be implemented? What should be the sequence in implementation? What aspects need detailed guidelines for implementation?
- 9) What mechanisms should be adopted for monitoring progress, evaluations and assessments of poverty impacts of interventions?

A checklist for designing pro-poor interventions at various levels:

- ✓ Are policies related to land, water and agriculture pro-poor?
- ✓ Are land and water rights and resource distribution pro-poor?
- ✓ Are measures to improve resource productivity pro-poor?
- ✓ Is distribution of direct and indirect net benefits of land and irrigation water pro-poor?
- ✓ Are investments in new infrastructural development or rehabilitation of existing infrastructure pro-poor?
- ✓ Are irrigation management institutions and newly created management organizations at various levels pro-poor?
- ✓ Are gender and diversity issues adequately addressed in interventions at various levels in a pro-poor framework?
- ✓ Are newly introduced irrigation and resource-conserving technologies and improved methods of production pro-poor?
- ✓ Are irrigation financing arrangements (cost recovery, irrigation service charges, irrigation spending) pro-poor?
- ✓ Are irrigation service delivery and performance targets and standards pro-poor?
- ✓ Is service delivery for agricultural inputs and access to inputs and services (credit, markets, information,) pro-poor?
- ✓ Are approaches to irrigation impacts monitoring, evaluations and impacts assessments pro-poor?

3. Main Findings, Conclusions and Lessons

3.1 Benefits and dis-benefits of irrigation

3.1.1 Direct and indirect benefits of irrigation

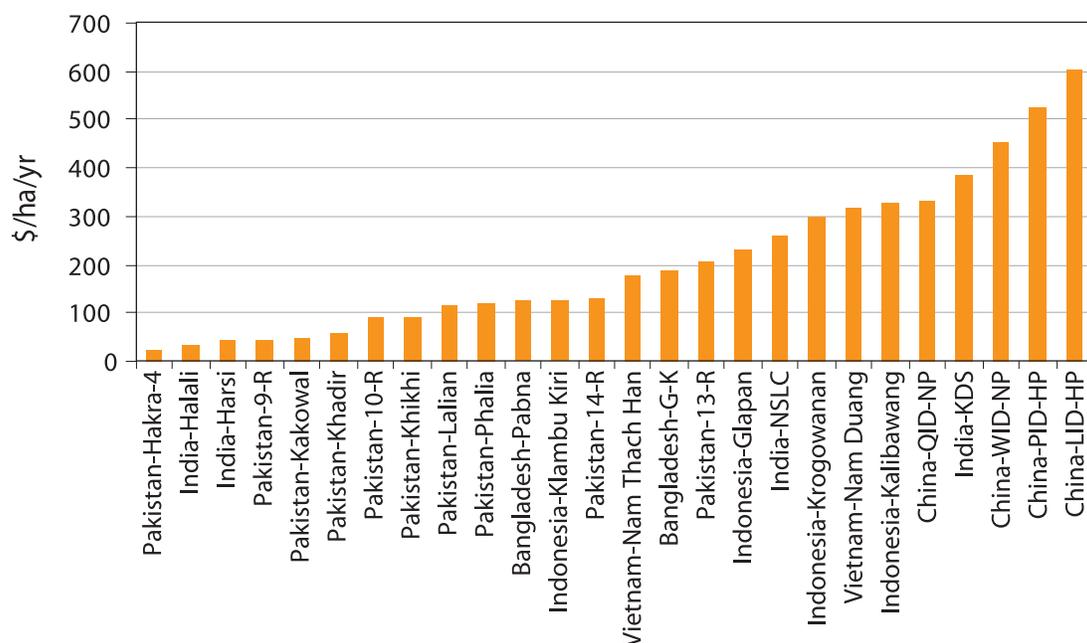
Direct production benefits

The direct productivity-related benefits derived from increases in average crop yield, ability to increase cropping intensity (the number of cropping per year per unit of land), and reductions in climatic risk, which make investments in other inputs more profitable and allow selection of higher-yielding crop varieties. Numerous studies provide evidence of the direct productivity-related benefits of irrigation.² Our studies showed that irrigated lands were more than twice as productive as nonirrigated reference areas,³ the net productivity benefits of irrigation (defined as

the difference in net output values between irrigated and nonirrigated lands), varied widely across settings from US\$23 to US\$600 per hectare, with benefits much lower in Indian, Pakistani and Bangladeshi systems (South Asia) compared to those in China and Vietnam (figure 4).

The benefits vary widely across systems, and depend on a range of factors including local conditions, system management, irrigation policy, and broader economic and political factors. In our 26 systems studied, irrigation benefits are generally large where crop productivity is higher due to higher yields and higher cropping intensity, farmers have better access to production inputs, management and maintenance of irrigation systems are relatively better, and where there is greater equity in land and water distribution across households and locations (as in Vietnam and China).

Figure 4: Net productivity benefits of irrigation.



² See Hasnip et al. 2001; Hussain and Hanjra 2003, 2004 for a detailed review of related studies.

³ Nonirrigated areas had an average net product value of US\$153/ha compared to US\$360/ha for irrigated settings. However, at least some of the difference is related to the fact that irrigated lands were likely more productive than nonirrigated lands even before irrigation was introduced.

Direct employment benefits

The construction and maintenance of irrigation systems provide direct employment benefits, typically to those living in or near the systems. While employment related to construction can be considered a one-time impact for laborers and suppliers of construction inputs, employment benefits related to maintenance continue for the life of any system. The exact nature and magnitude of the benefits for local labor, of course, depend on how and from where financing is obtained, and the degree of labor intensity of methods of works carried out, which would vary from one setting to another.⁴

Indirect employment and consumption benefits

Indirect local benefits from irrigation are primarily related to increased labor demand. Numerous studies have shown that irrigation raises employment by increasing the number of days of work per hectare, per crop season and per crop year. Further, irrigation-induced employment increases help smooth seasonal troughs in agricultural employment and improve and stabilize wage rates for agricultural laborers.⁵ While, sometime it is argued that mechanization associated with irrigation can actually displace labor, the net employment effects of irrigation-induced production increases are generally positive. Our country case studies provide further evidence on the significant contribution of irrigation to employment generation in agriculture. For example, annual labor work per hectare in the Ganges-Kobadak irrigation system of Bangladesh is around 100 days more than that in nearby nonirrigated areas.⁶ The productivity and employment benefits contribute to improved household incomes and consumption expenditures. Evidence from the studies shows that average household incomes and consumption can be up to 100 percent higher in irrigated than in nonirrigated settings.

⁴The data available from three systems, two in the Philippines and one in Sri Lanka (Udawalawe system) suggest a labor demand for maintenance of about 1 man-year per hectare of command area.

⁵Chambers 1988; Hussain et al. 2002 and Brabben et al. 2004.

⁶This additional labor demand translates not only into fuller employment for available on-farm labor but also employment of hired labor. For example, hired labor use in Sri Lanka's Udawalawe system is double that in nearby nonirrigated areas and the wage rate is 15 percent higher in the former than in the latter areas.

Box 7: Multiple uses of canal irrigation water can provide large benefits to the poor men and women, enhancing benefits of irrigation investments

While canal irrigation systems vary in terms of the multiple-use benefits they provide, the overall benefits can be large in most canal systems.

In Pakistan's Punjab and Sindh provinces canal water is commonly used for domestic and livestock purposes in areas of brackish groundwater.

In Sri Lankan canal irrigation systems, canal water uses for washing, bathing, homestead plots, fishing (in tanks) are quite common.

Water mills are commonly used for grain milling in Nepal, making a significant contribution to livelihoods of the poor families. For instance, our recent study in Nepal notes that a small watermill can grind 300-400 kg of cereals per day and generate a daily income of NRs 90-120 (or US\$1.1 to 1.5), (which is equivalent to US\$5.6 to 7.5 in purchasing power parity terms) for a family (Pariyar 2003).

Other local indirect benefits

In addition to its use in crop production, rural communities also use irrigation water for a variety of other purposes. These "multiple uses" of canal water, often neglected in the design and evaluation of irrigation systems, include: a) domestic supply—drinking, washing, bathing, homestead gardening/trees; b) urban water supply; c) livestock raising—animal drinking and bathing; d) fish farming; e) rural

enterprises and industries—brick making, water-powered grain milling, micro-hydropower generation; and f) transportation—use of canal embankments for transportation of goods and people, especially in areas with low road coverage. Many recent studies have highlighted the significant benefits and contributions to livelihoods, especially for poor households, made by these multiple uses.⁷

Further, many of these uses are nonconsumptive or consume only small quantities of water and so do not usually degrade the irrigation function of systems. While irrigation systems vary in terms of the multiple use benefits they provide, and some of the uses are difficult to quantify and monetize, it is important that such uses of water and their benefits, are recognized, identified and accounted for in designing irrigation interventions.

Broader level multiplier benefits.

The impact of irrigation in expanding local production and employment and increasing possibilities for nonagricultural water uses also has knock-on benefits for the wider regional and national economy. These benefits are typically referred to as multiplier effects. Examples of multiplier effects include the increased demand for farm inputs and stimulation of markets and industry to supply these inputs and reduction in food prices, improving consumer welfare and encouraging purchases and production in the nonagriculture sector. A multiplier is a measure of relative importance of direct to indirect benefits and is expressed as a ratio of total to direct benefits. While multiplier estimates vary widely due to differences in methodologies⁸, underlying differences in regional economic structures, and the degree of rural-urban links, it is clear that multipliers are generally substantial and often larger, sometimes significantly larger, than direct benefits. Thus, they are a critical factor in understanding the overall impacts of

Box 8: Multiplier benefits from irrigation-induced expansion in economic activities can be large

The value of multipliers varies widely across settings, from as low as 1.22 for a small-scale irrigation system in India to as high as 6.0 for New South Wales, Australia. In general, multipliers are higher in developed than in developing economies. At the same time, there is also wide variation between estimates for given countries and regions within a country. For example, multiplier estimates for India range from 1.22 to 3.15, though several studies estimate values around 2.

irrigation on both economic growth in general and on poverty reduction in particular.

The key findings of this section are that the indirect irrigation benefits can be larger than direct benefits. The distribution of irrigation benefits varies widely by type of the benefit and the socioeconomic status of the beneficiary. The direct benefits generally accrue to landholders while a significant part of the indirect benefits accrue to the landless and small farmers, positively contributing to their livelihoods. The key factors influencing direct production benefits of irrigation (such as crop productivity, irrigation system/infrastructural management and maintenance, access to production inputs and services and equity in land and water distribution) could be influenced through policy and management interventions. Further, the overall benefits of irrigation are large when irrigation-improving interventions, investments in infrastructure, improvements in system management and service delivery to farmers are

⁷ See for example, Jensen et al. 1998; Bakker et al. 1999; Meinzen-Dick and Bakker 1999; Meinzen-Dick and van der Hoek 2001; and Pariyar 2003.

⁸ For example, Input-output (I-O) models, models based on Social Accounting Matrices (SAM), and Computable General Equilibrium (CGE) models.

implemented in an integrated manner.⁹ Similarly, the direct productivity-related benefits could be enhanced through integrated approaches to provision of nonwater production inputs/technologies and services that help reduce transaction costs of access to them by farmers.¹⁰

Local-level direct and indirect benefits of irrigation can be enhanced through promoting labor-intensive production methods (e.g., diversification towards high-value crops); by improving access to land and water by promoting equity in distribution of these resources; and by promoting system designs that account for multiple uses of water in an integrated framework.¹¹ The broader-level multiplier benefits can be increased through other infrastructural development and with increased value addition to agricultural produce through development of agri-industries.

3.1.2 Direct and indirect dis-benefits of irrigation

On the other hand, irrigation can also lead to social, health and environmental problems. The potential adverse impacts of irrigation include displacement of people as a result of new large-scale irrigation development, public health risks from water-related diseases, reduced benefits from irrigation-induced land and water degradation, loss of biodiversity and river health risks from increased withdrawals of river water for irrigation. Often, negative social and

environmental consequences adversely affect the poor more than the nonpoor people. There has been wide publicity of these potential negative impacts of irrigation over the past decade, especially with the publication of the report of the World Commission on Dams (WCD) in 2000.

Irrigation and people (dis)-placement

Large-scale irrigation projects oftentimes involve some form of displacement of people either in terms of location or livelihoods or both. This could have a multitude of adverse impacts on the affected people and communities. However, the scale of displacement and its impacts would vary from one project to another depending on a range of factors including the size of the project and population density in the project area.¹²

The most critical issues in relation to displacement of people, apart from displacement itself, have been the lack of involvement of those affected in decision-making processes, inadequate compensation and lack of effective resettlement plans. In cases where those affected have been involved and compensation packages well negotiated with them, the process has led to better outcomes for resettlement (WCD 2000). However, there are no systematic studies assessing the post-displacement and resettlement impacts in terms of whether displacement and resettlement have actually led to making the displaced and resettled people and communities worse-off or better-off.

⁹Numerous other studies support this conclusion. For instance, a recent study in Vietnam assessed relative impacts of irrigation improving interventions—infrastructural rehabilitation only, management improvement only, and both infrastructural rehabilitation and management improvement (combined impact)—in three selected schemes where these interventions were undertaken. The study showed that the direct benefits to farmers from increases in farm output were much larger where infrastructural rehabilitation/improvement was combined with management improvements compared to schemes where only either infrastructural or management improvement was undertaken (Janaiah 2004). Our in-depth study in a typical canal in the Chaj subbasin in Pakistan showed that the direct benefits of irrigation can be significantly increased through improved canal water allocations that account for availability and quality of groundwater across locations, and concluded that the joint management of the two resources is important for realizing these benefits (see Hussain et al. 2003 for more details).

¹⁰Hussain and Perera (2004) provide a review of case studies demonstrating benefits from integrated service provision in agriculture.

¹¹Our recent study in the Kavre district in Nepal showed the yearly average income of a household is almost twice (NRs 222,947 or US\$2,751) for those households having good access to water for drinking as well as for irrigation compared to those having poor access to them (NRs 112,725 or US\$1,391).

¹²The WCD surveys of dams reported physical displacement in 68 out of the 123 dams surveyed. Tarbela dam in Pakistan led to the displacement of around 96,000 people from 120 villages, with many more indirectly affected. There were serious issues related to lack of involvement of those affected in decision-making processes, lack of information sharing, and inadequate compensation and resettlement of the affected people. Some of those affected who held valid allotment letters have not been given land due to unavailability of land or some other reasons (Asianics Agro-Dev 2000). Similar issues have emerged in the recently completed Chashma Right Bank Irrigation Project-III (CRBIP-III) in Pakistan which covers a 144-km long canal with a command area of 135,000 hectares (BIC 2003). In Sardar Sarover project in India, estimates suggest that the project will lead to total or partial submergence of around 240 villages and nearly 100,000 people will have to be rehabilitated and resettled (Sabnis 2001).

Box 9: How can the adverse consequences of irrigation-led people displacements be minimized or avoided?

The following actions could help avoid or minimize adverse impacts related to people displacements:

- a) explore the options for minimizing people displacement at the time of project preparation/initiation;
- b) develop legal frameworks for addressing the displacement issues;
- c) involve communities in decision-making processes right at the planning stage of the project, and establish effective mechanisms for information sharing and complaints hearing;
- d) develop compensation and resettlement plans; discuss compensation and resettlement packages with affected communities, through participatory consultation processes; include the landless and tenants in the compensation and resettlement plans; and provide fair and adequate compensation to those affected, particularly the poor households including small and marginal farmers, tenants, and the landless laborers;
- e) involve NGOs in negotiation of compensation packages and implementation of the resettlement plan; and
- f) include resettlement cost as a part of the project cost or loan package.

On the other hand, there are also examples where development of irrigation systems has actually led to placements of the (displaced) poor people from overcrowded urban areas or from marginal areas to provide them sustainable livelihood opportunities. Resettlement schemes developed with medium and large-scale irrigation development in Sri Lanka are good examples of such placements—where by 2000, the Mahaweli Authority of Sri Lanka had settled 131,640 families or around 673,000 persons in its schemes.¹³ These are clearly large benefits of irrigation development, and should be accounted for.

Irrigation and human health risks

Irrigation can introduce diseases, as adding water to the drier areas can create an environment favorable to vectors and pathogens. Some 30 diseases have been linked directly or indirectly to irrigation projects, including diseases that are waterborne, water-washed, water-based and water-related insect vectors.¹⁴ Among the most important ones are malaria, schistosomiasis, cholera and diarrhea, with malaria having the larger risks and impacts. A study in South Punjab in Pakistan found that major malaria vectors were in irrigated and waterlogged sites and were directly and indirectly linked to canal irrigation systems. The study suggested that vector breeding can be reduced through improved management of canal water.¹⁵ Similarly, a detailed study in nine small irrigation reservoirs or tanks in North Central Sri Lanka concluded that irrigation tanks certainly contributed to malaria risk in Sri Lanka, and suggested that both rehabilitation and continuing improvements in management are necessary to maintain tanks in a condition in which they pose minimum disease risks that affect the lives and livelihoods of the poor rural communities.¹⁶

On the other hand, there is evidence that irrigation can actually reduce malaria risk by improving the

¹³The number of families that have been allocated lands and settled in all schemes in the country as a whole is much larger than this number.

¹⁴See Olivares 1994.

¹⁵See Mukhtar et al. 2002.

¹⁶See Amarasinghe et al. 2001.

socioeconomic status of households¹⁷ (this should be accounted for as one of the indirect benefits of irrigation). Further, most work on irrigation and human health-risk linkages suggests that irrigation systems can be designed and managed to reduce or even eliminate negative health risks and impacts. A number of case studies in Asian countries, including India, Indonesia and China have shown that irrigation management interventions could be designed to lower the incidence of water-related diseases.¹⁸

Irrigation-induced land and water degradation

Irrigation can also cause degradation of land and water resources in the long term. The expansion in irrigated agriculture could lead to salinity and waterlogging, soil erosion, pollution of surface water and groundwater from irrigation-linked use of excessive chemicals and fertilizers in crop production, and increased nutrient level in the irrigation and drainage water resulting in propagation of aquatic weeds. Among these, land degradation in the form of waterlogging and salinity has serious long-term adverse impacts and could threaten the sustainable use of soil and water resources and overall food production systems. Irrigation-induced land degradation is particularly severe in South Asia and China. The problem is severer in highly populated agricultural intensive areas. In India, 42 irrigation systems are reported to be affected by salinity problem. The total area adversely affected from irrigation-related problems (particularly waterlogging and salinity) has been estimated at 5.743 million hectares, and a decline of 30 to 50 percent in the crop yields has been registered on the farms affected by waterlogging and salinity.¹⁹ In Pakistan, secondary salinity associated with a high water table resulting

Box 10: Avoiding or minimizing negative impacts of irrigation

The reviews, discussions and findings of the study suggest that many of the potential adverse impacts of irrigation can be avoided or minimized with effective planning, design and management of the projects. What is needed is to:

- a) establish effective mechanisms to ensure that environmental impact assessment (EIA) and health impact assessment (HIA) guidelines are followed in implementing the projects;
- b) develop a pre-project knowledge-base on social, ecosystem and environmental parameters to establish a benchmark for assessing performance of irrigation; and
- c) establish effective mechanisms for post-project monitoring and impact assessments to identify opportunities to minimize negative impacts, such as land and water degradation, water quantity and quality impacts on downstream users, through involvement of communities and maximize positive impacts.

from irrigation is a particular problem. According to the official estimates, around one-tenth of the country's best agricultural land is affected by salinity. These problems are particularly acute in Punjab and Sindh. In Sindh, about half of the soils are saline, of which 18 percent are strongly saline. The studies estimate that waterlogging and salinity have led to a 30

¹⁷A recent IWMI study comparing malaria in irrigated and nearby nonirrigated/rain-fed/chena (i.e., slash and burn cultivation) areas showed that malaria risk was higher in areas with more than average rainfall or large areas under forest cover or in chena cultivation areas. Irrigated areas had a low risk for malaria. People in the irrigated areas had a higher socioeconomic status than those in the chena areas and therefore lived in better-constructed houses, made more use of bed nets and medication, and had a generally higher nutritional (health) status. The study showed that malaria risk was higher outside the irrigated areas and was associated with the lower socioeconomic status, chena cultivation and presence of abandoned tanks (Klinkenberg et al. 2003).

¹⁸For example, the studies suggest that alternate wet/dry irrigation (AWDI) method in rice cultivation could lead to a lower incidence of malaria and Japanese encephalitis, with dual benefits of water saving and human-disease control, while maintaining rice yields at least at the same level (Van der Hoek et al. 2001)

¹⁹Shishodia 1996.

percent decline in yields of major crops in Pakistan.²⁰ Further, the adverse impacts of resource-degradation problems are realized not only at the farm level in terms of reduced resource productivity and returns to farming but also at the regional level in the form of displacement of labor from agriculture resulting from reduced production, and at the national level in terms of reduced agricultural contribution to the national income.²¹ Most of the problems related to land and water degradation emerge from poor management of irrigation and irrigated agriculture, and affect the poor, marginal and small farm households, that often lack financial and other means to take preventive measures, than the nonpoor households. There are a range of intervention options to minimizing them, such as improving irrigation management, establishing proper drainage systems, promoting conjunctive use of

surface water and groundwater, and improving crop management and selection of crops depending on their suitability to different salt levels.

3.1.3 Typology of direct and indirect (dis)-benefits of irrigation

The study develops a generic typology of direct and indirect benefits and dis-benefits of irrigation (table 1) that can be used to identify and influence different types of irrigation benefits and dis-benefits for enhancing net benefits to the poor. For poverty reduction, our typology of irrigation benefits adjusted to particular local and regional conditions can provide a valuable framework for developing strategies to target irrigation investments and develop a pro-poor irrigation policy. While any specific strategy for targeting irrigation interventions in support of poverty

Table 1: Typology (and examples) of irrigation benefits and dis-benefits/costs.

Type	Benefits	Dis-benefits/costs
Type – 1	Direct benefits related to expansion in employment from construction, rehabilitation and maintenance of irrigation systems, placements of the poor people.	Direct dis-benefits related to displacement of the poor households, and potential for land encroachments.
Type – 2	Direct benefits related to irrigation-induced expansion in crop productivity.	Direct dis-benefits related to land degradation from salinity, waterlogging, overuse of chemicals resulting in reduced agricultural productivity.
Type – 3	Localized indirect benefits related to productivity-induced benefits from increases in employment, wages, income and consumption in local settings.	Localized indirect dis-benefits due to irrigation-induced land degradation resulting in labor displacement; irrigation-led mechanization and use of labor-saving methods of cultivation—leading to unemployment.
Type – 4	Other localized benefits from multiple uses of water, groundwater recharge, increased private investments in irrigated agriculture.	Other localized dis-benefits—public-health risks, loss of biodiversity, water pollution.
Type – 5	Broader-level multiplier benefits from linkages with nonagriculture sectors.	Broader-level dis-benefits—water transfer for irrigation with potential negative impacts on the health of rivers and sustainability of river systems with potential adverse impacts on the livelihoods of river-dependent poor communities.

²⁰Pinstrup-Anderson and Pandya-Lorch 1994; Mustafa and Pingali 1995.

²¹Joshi et al. 1994.

reduction necessarily requires an understanding of the relative magnitudes of each of the various benefits, use of the general typology presented here helps ensure that the main issues are not ignored and allows some general suggestions, which can form the basis of decision making. For targeting irrigation benefits to the poor, the main lesson from the discussion is that appraisals of irrigation projects, evaluations and related policy and project development need to take into account the full range of (dis)-benefits identified here.

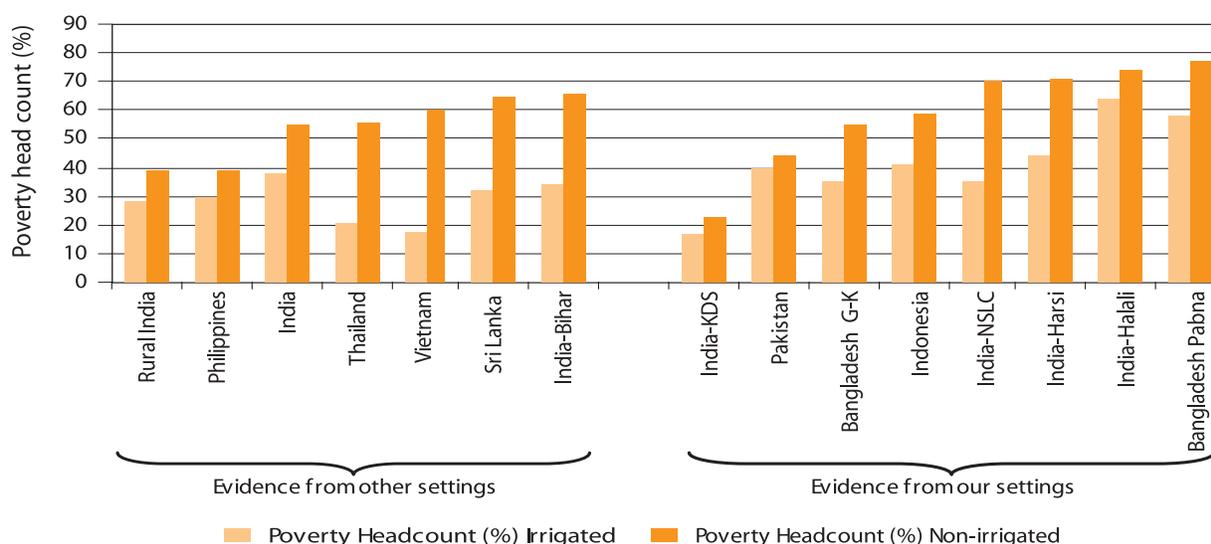
3.2 Irrigation and poverty alleviation impacts

The direct and indirect net benefits of irrigation contribute to poverty alleviation. Evidence from comparisons of poverty across irrigated and nonirrigated settings shows that, on average, poverty incidence is over 21 percent less in irrigated than in nonirrigated settings, with substantial variation in poverty incidence across countries/systems. Evidence using quantitative methods shows that irrigation and agricultural output are significant positive determinants of incomes/expenditures and negative determinants of poverty. Further, more in-depth analyses using a concept of dynamic poverty (i.e., chronic/permanent and temporary/transient poverty) such as those by Hussain et al. (2002) in the Udawalawe system in Sri Lanka show that the incidence of chronic poverty is significantly lower in irrigated (32%) than in nonirrigated settings (65%). Moreover, the average period the poor households experience temporary poverty is shorter (5.85 months/year) in irrigated than in nonirrigated settings (8.44 months/year). These findings imply that irrigation reduces not only chronic poverty but also the duration of temporary poverty. Overall, the available evidence clearly suggests that irrigation has significant impacts on poverty reduction. However, the strength of the relationship and the magnitude of response of poverty reduction to irrigation or farm output vary considerably across settings.

Box 11: How prevalent is poverty in irrigation systems?

- Irrigation significantly reduces poverty. While, poverty is still high in irrigation systems estimated at 33.5 percent across systems, it is much higher (almost twice) outside irrigation systems in nonirrigated areas.
- Across the 26 irrigation systems, poverty incidence varies from as low as 6 percent to as high as 65 percent.

Figure 5. Poverty (%) in irrigated and non-irrigated settings.



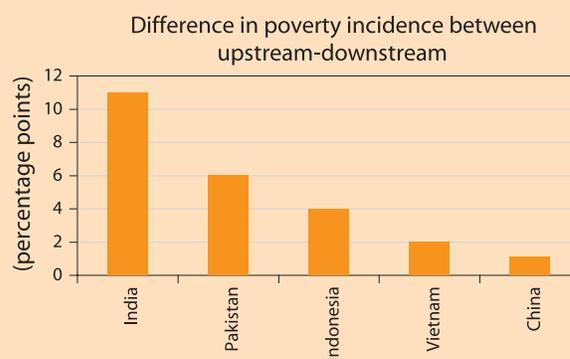
Poverty differs not only across irrigated and nonirrigated settings but there are even large differences in poverty across irrigation systems. Among our 26 systems, poverty incidence varies from as low as 6 percent to as high as 65 percent. The average poverty incidence across all the systems is estimated at 33.5 percent, with the lowest poverty in Chinese systems and the highest poverty in Pakistani systems. As expected, overall poverty incidence is much higher in South Asian systems than in Chinese and Vietnamese systems studied. To a significant extent, these reflect the general level of economic achievement among the countries. Also, there are not only inter-country differences in poverty in irrigation systems but also significant intra-country differences in poverty and these differences are much larger among South Asian systems.

The study findings show that there is generally more poverty at downstream than at middle and upstream reaches of irrigation systems. However, the upstream-downstream poverty differences are more pronounced for systems in India and Pakistan than those in China, Vietnam and Indonesia where such differences are only very small (figure in box 12). Among all the systems studied, downstream poverty is higher in more than half (62 percent) of the systems. Further, these locational differences in poverty are more apparent in those downstream areas where access to canal water is least, alternative sources of water are limited or of poor quality and/or alternative sources of employment/livelihoods are very limited.

The poverty situation gets worse in those downstream reaches where there is no or little access to canal water, groundwater quality is poor and access to alternative sources of livelihoods is limited. Also, in such situations the poor tend to be poorer than the poor at upstream reaches.²² In Chinese and Vietnamese systems, head-tail differences in poverty are not as pronounced as in South Asian systems.

Box 12: Higher poverty in downstream reaches of canals in South Asian systems

- In South Asian systems, poverty is generally higher at downstream/tail reaches, especially in areas where access to canal water is least, groundwater is of poor quality and alternative sources of livelihoods are more limited. In Chinese and Vietnamese systems, head-tail differences in poverty are not as pronounced as in South Asian systems.



Poverty is high among agricultural-dependent landless households followed by marginal landholders. Unlike Chinese and Vietnamese systems where generally there is no landlessness, around one-third of households in Indian and Pakistani systems studied are landless (and generally waterless). The landless households account for the majority of the poor who depend on non-crop sources of income including on-farm and off-farm wage labor. Overall, our studies suggest that poverty is related to productivity levels, (in)equity in distribution of land and irrigation water and locational factors. Poverty is low in settings with

²²A recent study by Rajagopal et al. (2002) on tail-end deprivation in irrigation systems in Tamil Nadu, Karnataka and Maharashtra also conclude that: a) tail or lower reaches of canals are disadvantageous locations; b) upper-reach farmers are powerful in terms of social and economic conditions. The living standards of the upper-reach farmers are better in terms of food, clothing, transport, electronics and luxury equipments whereas the people at tail ends are just surviving; and c) the extent of tail-end deprivation is unequal and varies across the systems.

better productivity performance and with more equitable distribution of land and irrigation water, and vice versa.

Factors influencing poverty-reducing impacts of irrigation

The magnitude of antipoverty impacts of irrigation depends not only on the availability of irrigation but also on productivity performance of the systems and, importantly, on the distribution pattern of land and irrigation water. Where land distribution is relatively inequitable, irrigation water distribution in terms of total amount per households also becomes inequitable, and vice versa. From a poverty-alleviation perspective, both productivity performance of the systems (size of the pie) as well as distribution of land and irrigation matter (distribution of the pie).

As shown in table 2, our systems across countries differ significantly in terms of access of households to land/water, their distribution pattern, farm sizes and productivity performance. A household average landholding size varies from as low as 0.40 ha/household in Vietnam to as high as 4.3 ha/household in Pakistan. Average landholdings are much smaller (less than 1 ha/household) in Chinese, Vietnamese and Indonesian irrigation systems than in Indian and Pakistani systems. Unlike in South Asian systems, there is no landlessness in the Chinese and Vietnamese systems studied, and overall land distribution is



relatively equitable as indicated by low Gini coefficients. This is basically an outcome of land-equity policies adopted in these countries over the past decades. Given that the system-level irrigation distribution generally follows land distribution patterns, irrigation distribution tends to be equitable or even pro-poor in these countries. Our study in the Chinese systems shows that the poorest farmers who rely more on farming have the greatest access to water when measured in terms of per capita or per household irrigation water use (see Wang et al. 2004). Overall, when there is greater equity in land and water distribution, irrigation is itself pro-poor.

Table 2: Land and water-related factors across countries in selected systems.

	Farm size (ha)	Gini coefficient	Crop intensity	Productivity in SGVP (US\$/ha/yr.)	Irrigation benefit (US\$/ha)	Non-crop income (%)	Poverty headcount (%)	Landlessness (%)
Bangladesh	0.9	0.70	196.0	692.5	157.0	76.9	46.5	15.0
India	2.4	0.53	99.0	985.5	180.5	59.3	40.0	37.5
Pakistan	4.3	0.51	153.6	448.5	94.1	63.2	51.7	27.7
China	0.7	0.19	177.0	1661.3	477.5	64.1	7.0	0.0
Vietnam	0.4	0.25	196.5	1577.0	264.0	73.5	15.0	0.0
Indonesia	0.7	0.57	238.5	1001.8	375.8	41.8	41.0	19.8

Box 13: Is equity in resource distribution good for productivity improvements and poverty alleviation?

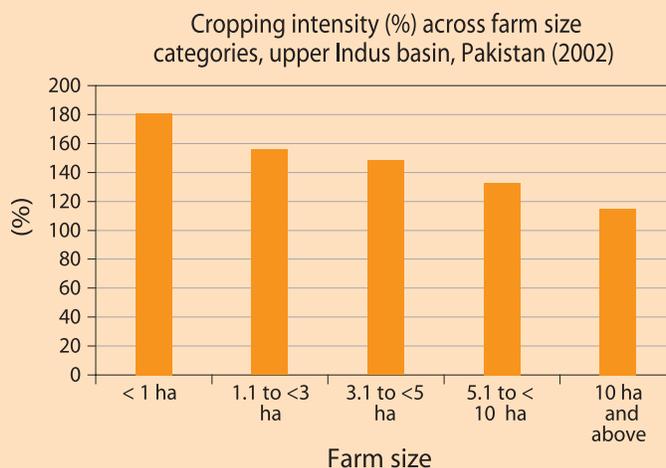
Results of our study suggest that there is a greater equity in land and water distribution in Chinese and Vietnamese systems than those in South Asian countries. The farms in the former countries are of smaller sizes (less than 1 hectare) than in the latter. Inter-country comparisons of data on crop productivity show that farms in China and Vietnam are more productive than those in South Asian countries. In Bangladesh and Indonesia, while the overall average of farm size is small, there is high inequity in land distribution, with a large number of very small farms having only a small proportion of all land and vice versa. In India and Pakistan, the average of farm size across households is relatively larger, inequity in land distribution is very high, and overall productivity levels are also low. Further, intra-country farm household level data show that intensity of crop production on smaller size farms is higher than on larger-size farms. Our detailed survey of 1,224 farms across 10 distributaries in the upper Indus basin in Pakistan shows that cropping intensities are inversely related to farm sizes, that is, per hectare annual cropping intensity for the largest size farms is significantly lower than that of the smallest size farms (as shown in the figure below). Land-rich farmers tend to underuse their holdings while the land-poor do not have access to sufficient land.

While several factors influence productivity performance (including cultural and political, which are beyond the scope of this report) equity in land distribution and farm sizes also matter. This conclusion is further supported by the more recent work on the subject. A recent study by the World Bank for Pakistan as a whole shows that households with larger operated areas have lower yields and are less-productive, and that land inequity leads directly to lower productivity (World Bank 2002). Further, there are numerous other recent studies in several settings suggesting that small farms produce more per unit of land than large farms in developing countries (see Fan and Chan-Kang 2003 for recent reviews on the subject).

The above findings suggest that greater equity in land distribution that leads to larger number of smaller-size farms of *viable sizes* will not only benefit a larger number of households from land but also help improve productivity and lead to more equitable distribution of direct benefits of irrigation investments (as the two resources are linked), leading to greater impacts on poverty. For irrigation investments to be directly pro-poor, they should benefit a larger number of smaller farms rather than only a smaller number of large farms.

Making Irrigation investments pro-poor

For irrigation investments to be pro-poor, the criteria should be not only hectares developed/rehabilitated, but also the number of households/farms/persons benefited; and not only the aggregate productivity benefits but also the various types of benefits and the share of the poor in total benefits.



Poverty elasticity of irrigation and outputs

The study findings indicate that irrigation systems vary significantly in terms of their crop-productivity performance. The estimated elasticity of poverty reduction with respect to the crop productivity performance varies across countries from -0.15 to -4.42, indicating that a 1 percent increase in productivity reduces the poverty incidence from 0.15 percent to 4.42 percent (with average value of elasticity estimated at -0.29). The elasticity estimates here measure poverty reduction response to productivity improvements in the *local settings* through *direct productivity benefits* (Type 2) only. The elasticity estimates are much higher for China (-4.42) followed by Vietnam (-0.91) and much lower for South Asian countries (from -0.15 to -0.28). Our findings are generally consistent with those from the broader literature in that poverty elasticities are higher where initial inequities in resource distribution and poverty levels are relatively low and vice versa.²³ In other words, where inequities in resource distribution are high, poverty levels also tend to be high, and poverty elasticities are low. These results should not be interpreted to mean that there is little scope for poverty reduction, but rather that they suggest resource inequity is an important constraint to poverty reduction. In settings where such a constraint has been addressed (as in China and Vietnam), poverty

elasticities of expansion in irrigation and farm outputs are very high. Average response/estimated poverty elasticity with respect to land equity is 0.38 indicating that a 1 percent decrease in land Gini coefficient would reduce poverty by 0.38 percent. This effect captures the effects of both land and irrigation distribution, as the two broadly move together. These results imply that, as for productivity improvements, land and water distribution equity is also important or even more important for poverty reduction.

Overall, our results suggest that access to, and distribution of, land and irrigation and productivity performance of irrigation systems have significant impacts on poverty in the local settings. Further, the poverty reduction impact is much greater in systems where there is greater equity in land and irrigation distribution and productivity performance is better and vice versa. The disaggregated analyses for countries suggest that demographic and locational characteristics of households are also important in influencing their poverty, especially in South Asian systems studied. The probability of a household being poor is significantly higher for those having larger-size families, especially those having a larger number of dependents, than those having smaller-size families. Similarly, the probability of a household being poor in the middle reaches of the systems is much lower than those located at the head and tail ends (as the

²³Estimates of poverty elasticities of irrigation or farm output from other recent studies suggest that they vary widely across settings, countries and regions within countries from as low as -0.1 percent to as high as -1.34 percent. The average poverty elasticity estimates with respect to farm output (i.e., direct benefit of irrigation) from several studies are closer to -0.35, indicating that a 1 percent increase in farm output leads to a poverty reduction by 0.35 percent. Our findings on poverty elasticity with respect to productivity increases are in line with those from the recent broader development literature in that poverty elasticities are much lower in settings where initial levels of poverty and inequities in resource distribution (land and water) are high (see Birdsall et al. 1995; Timmer 1997; Datt and Ravallion 1998; Deininger and Squire 1998; Sarris 2001; Heltberg 2001; and Jalilian and Weiss 2004). For example, Birdsall et al. (1995) show that the elasticity of poverty reduction with respect to growth declines sharply with increasing inequality. With a very low Gini coefficient of 0.25, the elasticity is very high at 3.33, while it drops by almost half to 1.82 with a Gini coefficient of 0.59. Deininger and Squire (1998) show, by using the initial distribution of land as a proxy for the asset distribution, that asset inequality has a significant negative effect on subsequent growth and this effect is stronger in low-income countries than in high-income countries. Similarly, Sarris (2001) argues that initial inequitable land distribution makes the relationship between agricultural growth and the overall growth much weaker. Further, Heltberg (2001) shows that the poverty elasticity depends on the degree of inequality and falls quite strongly as the Gini coefficient increases, and also poverty elasticity is low where the initial level of poverty is high. A cross-country study by Jalilian and Weiss (2004) further confirms that countries that start with a higher level of inequality suffer more poverty.

Further, the poverty elasticities are significant in relation to both direct and indirect benefits of irrigation. However, poverty elasticities with respect to indirect benefits are much larger than those from the direct benefits in the long run than in the short run. This is because a significant part of the indirect benefits, especially through employment and price effects, goes to the poorest socioeconomic class, generally landless. de Janvry and Sadoulet (2002) show that a 1 percent increase in land productivity increases total real income of landless by 0.75 percent and of small farmers by 0.50 percent, with indirect benefits contributing to total income gains by 92.5 percent for landless and 56.4 percent for small farmers. However, under certain conditions, the poverty impacts of direct productivity benefits of irrigation could also be very strong. For instance, van de Walle (1996) shows that in Vietnam (where land distribution is relatively equitable) converting a 10 percent of nonirrigated land to irrigation leads to an increase in crop incomes that constitute from 0.1 percent to 4.52 percent of household average expenditures, with the largest impact on the lowest expenditure group and vice versa. Further, he suggests that targeting the irrigation expansion to households with small per capita landholdings produces the most progressive incidence of gains as well as the largest absolute benefits to the poor.

productivity levels are generally better at middle reaches due to the relatively less extent of waterlogging (as at heads reaches) and less water shortage (as at tail reaches)).

Poverty-reducing impacts of irrigation: small-scale vs. large-scale

Poverty outcomes for canal-irrigation systems of varying sizes are mixed. There is no systematic pattern of poverty increasing or decreasing with size of systems. However, the pattern of higher downstream/ tail-end poverty is more pronounced in larger-size systems than in smaller-size systems. While tail-end poverty performance is better in smaller systems, overall mechanisms for poverty alleviation and constraints therein are similar across large-scale and small-scale systems.

Groundwater irrigation has a relatively greater impact on output levels and poverty reduction because of its greater reliability and better control over water supplies, but this is only in settings where groundwater is of good quality. In settings where groundwater is of

marginal quality, the impact of canal water on output and poverty is much larger than of groundwater irrigation. Further, canal water attracts private investments in groundwater (and other factors of production). Overall benefits of canal water can be very large when groundwater-recharge benefits of canal water are also accounted for.²⁴

Poverty-reducing impacts of interventions: irrigation vs. other interventions

The study findings, based on extensive review of related studies on the subject, suggest that no single intervention is sufficient for effective poverty alleviation. Irrigation is found to be one of the most important interventions for poverty alleviation along with land, education and roads infrastructure. Poverty reduction impacts of irrigation are large when these and other complementary elements such as market systems are in place. Further, the poverty-reducing impacts of irrigation can be enhanced through simultaneously implementing complementary interventions in an integrated framework.



²⁴A recent study by Fan and Hazell (2000) in India estimates that a 1 percent increase in crop area under canal irrigation increases crop area under private groundwater irrigation by 0.22 percent in irrigated areas and by 0.58 percent in high potential rain-fed areas. However, more research is needed to fully understand groundwater-canal water dichotomy to answer questions such as: do poor people have equal access to groundwater? what are the differences in poverty impacts of privately owned vs. publicly or communally owned groundwater infrastructure? and how can the access of the poor to groundwater be improved?.

3.3 Irrigation, gender and diversity²⁵

There are strong linkages between irrigation, gender, diversity and poverty issues. The study findings suggest that women make large contributions to irrigated agriculture. They depend on, and benefit from, irrigation water in a variety of ways including water uses for domestic and livelihood purposes. The study indicates that in male farming systems²⁶ of South Asia, poverty is generally higher among female-headed households than among male-headed households. Female poverty is

likely to be much higher among female-headed households, particularly those belonging to low castes, clans, tribes and ethnic minorities in such systems. While there are no significant differences in poverty incidence across female-headed households and male-headed households in systems that are almost dual systems, as in Vietnam,²⁷ poverty is high among ethnic minorities in these settings.

Participation of women and low-caste households in irrigation management institutions and decision-making processes thereof is very low

Box 14: Examples of initiatives with a pro-poor and pro-gender focus

There are examples of initiatives where women have benefited when gender and poverty issues were explicitly incorporated in policy and project-level interventions in irrigation and were implemented through establishing effective mechanisms.

- In Bangladesh, Labor Contracting Societies (LCS), Embankment Maintenance Groups (EMG), and Channel Maintenance Groups (CMG) have been established in irrigation systems providing employment and income-generating opportunities to the rural people, both men and women, and ensuring fair wage and achieve high quality of maintenance work. At least 25 percent of the earthwork of any public water project/subproject/scheme is supposed to be reserved for the LCS. The affiliated agency is in charge of the recruitment of female laborers willing and capable of engaging themselves in an EMG/CMG for a period not shorter than 6 months. Priority would be given to Female-Headed Households (FHH). The majority of the members of both EMG (as in the G-K system) and CMG (as in the Pabna system) are vulnerable women. In addition to earning from wage labor, women use the slopes of the canals and the embankments to harvest vegetables and thereby earn an extra income.
- Of the four systems studied in Indonesia, women were relatively more active in only one system (Krogowan), where they were organized through women from the Study Center of Diponegoro University. The main lesson here is that women's participation in irrigation institutions can be enhanced through effective approaches in mobilizing and organizing women by the women.
- Further, if irrigation systems are better planned and designed for multiple uses of water, in which domestic uses are also given priority, more benefits can be derived from the same irrigation scheme, especially for women. For example, in the design of rehabilitation/further extension of the Udawalawe scheme in Sri Lanka, 51 new structures were built to facilitate such domestic uses of water, benefiting especially the women.

²⁵Comments and inputs in this section from Drs. Barbara van Koppen and Liqa Raschid Sally of IWMI are gratefully acknowledged.

²⁶Van Koppen (2002a) offers a useful classification of local farming systems based on gender of farm decision makers as: a) male farming systems—if only a minority of farm decision makers (less than one-third) is female; b) dual or mixed farming system—if male to female proportion of farm decision makers is roughly equivalent; and c) female farming system—if the majority of farm decision makers (more than two-thirds) is female.

²⁷See Vietnam component of our study (Tuan *et al.* 2004).

in male farming systems of South Asia. Lack of their involvement means not only ignoring continuing inequities in participation and decision-making processes but also missing out on opportunities for enhancing local benefits of irrigation investments through their participation. Overall, gender and diversity issues are critical in irrigation management that aims to address poverty issues. An understanding of these issues is important to design pro-poor interventions.

Women and low socioeconomic groups have benefited where gender and diversity issues have been incorporated in policy formulation, project design and implementation. Designing the irrigation infrastructure such that the irrigation systems become multiple use systems can enhance benefits of investments in irrigation to the poor, particularly women (box 14).

Overall, it is concluded that as much as there is gender discrimination, there is also discrimination of minorities and along caste and ethnic lines. The policy- and project-level interventions need to focus for improving gender and diversity performance²⁸ not only in areas predominantly inhabited by the poor belonging to low castes, clans, tribes and ethnic minorities, but also in areas where such groups are in minorities. Further, there is an important gender dimension to diversity/caste/minorities issues.²⁹

3.4 Irrigation system performance

Irrigation system performance affects poverty. The comparison of key performance indicators across countries (such as crop productivity, net irrigation benefits per unit of land, head-tail equity in water and productivity, poverty head-count across canal reaches,

irrigation service charge level and collection efficiency, access to nonwater inputs and services) suggest better performance of Chinese and Vietnamese systems than Pakistani and Bangladeshi systems. There is a range of factors that influences the magnitude of antipoverty impacts of irrigation performance. Based on the review of recent studies, our country study findings, and analysis and synthesis of lessons from the country studies, we classify factors influencing irrigated-system performance and poverty into three broad categories as: a) micro/local level—*underlying structural factors* (such as land tenure systems, structure of land distribution, water distribution

Box 15: Factors influencing irrigation system performance and poverty linkages

Among the most important factors influencing poverty reduction impacts of irrigation system performance are:

- Structure of land and water distribution—(in) equity in land and water distribution—and their quality,
- condition of irrigation infrastructure and its management,
- irrigation water management, rights, allocation and distribution procedures and practices,
- access to and adoption of irrigation and production technologies/methods, cropping patterns and crop diversification,
- access to support services (e.g., information, input and output marketing).

²⁸van Koppen (2002) develops a useful gender performance indicator for irrigation (GPII) that consists of four key elements: a) access to water at farm level (water and land rights), b) inclusion in forums (land and membership rights), c) inclusion as leaders, and d) ability to function as leaders.

²⁹It is commonly known that females in poor households bear a disproportionate burden of poverty. Females in low caste/minority households, particularly those in female-headed households, may suffer from the worst form of socioeconomic deprivation. From a gender and social hierarchy standpoint, households can be classified in terms of female deprivation and poverty into the following four categories: a) females in high-caste/majority male-headed households; b) females in high-caste/majority female-headed households; c) females in low caste/minority male-headed household; and d) females in low-caste/minority female-headed households. The households can be sub-classified based on whether or not a household is dependent on agriculture as the main source of income. It can be hypothesized that female deprivation and poverty increase in successive categories, with females in the fourth category being the most deprived, especially in South Asia. However, more research is needed to confirm such relationships.

practices); b) meso/intermediate level—*institutional/management factors* (such as system-level irrigation management institutions, infrastructural management, O&M of systems, production-market linkages at the regional level); and c) higher macro level—*contextual factors* (such as investment policy, land policy, input subsidy/tax policy, price support policy). Some of the important factors that can be influenced through policy- and project-level interventions are identified in box 15. There may be other factors that may also influence irrigation performance, such as cultural and political factors; however, their detailed analysis is beyond the scope of the study.

Local-level water rights and allocation methods

Lack of well-defined irrigation water rights is one of the causes of poor irrigation performance, adversely affecting the poor more than the nonpoor. The traditional customs and laws relating to water resources and their use are now being increasingly questioned in the context of irrigation-performance improvement and institutional reforms. It is being argued that the customary rights lack legal standing and formalized secure water rights offer a way to the poor to protect their water resource from being taken away and that a different system of water rights has to be brought in place to remedy the ills plaguing the water resources sector. Clear and secure water rights can play an important role in providing water allocation equity and efficiency, and in expanding opportunities for poor people to move from poverty to prosperity. On the other hand, there is also an argument that reforming water rights is not easy and may require changes in many institutions and laws and may face many obstacles. Moreover, there are also concerns that the formalization of water rights may expand opportunities for the wealthier, more powerful, and large landholders to manipulate water rights systems to serve their interests.³⁰

Like in most other developing countries, water resources in our study countries belong to the state. Land and water rights are generally linked, except in China where the two resources are de-linked, and users are given the use rights. At the higher levels in canal systems, water is allocated administratively, based on historical rights, canal capacities and agro-climatic conditions. At the lower or tertiary levels, water distributions are based on a range of customary water rights, though in some cases as in Pakistani Punjab water rights have been formalized through official recognition (as from the informal to the formal warabandi system). On the other hand, in Andhra Pradesh and Madhya Pradesh in India, the traditional practice of first farmer gets first is common.

Box 16: Rotational system of water distribution for greater equity in sharing water

Our studies in the Ganges Kobadak system in Bangladesh show that proper maintenance of infrastructure and effective implementation of rotational water supply methods could lead to significant improvements in system performance. For example, in one of the distributaries (S8K) in the G-K system the condition of infrastructure and hydraulic structures was very poor, water distribution was highly inequitable across head and tail reaches of the system. The repair and maintenance work was carried out and a system of the 10-day rotation (with 5 days on and 5 days off) was effectively implemented and farmers' participation encouraged. As a result of these improvements, area irrigated in the distributary increased from 54 hectares to 528 hectares in the next season. The water distribution among tertiaries and across head and tail locations also became much more equitable (Ali 2000).

³⁰See Bruns 2004.

There is a greater flexibility in water allocation and distribution in the Chinese systems and a range of allocation methods are employed according to local conditions³¹ and the overall performance of systems is better than in the systems studied in other countries. While retaining flexibility, emphasis should be given to negotiations of rights and allocation rules within and across systems and among bulk water users in a basin by involving stakeholders. Based on our comparison of systems we identify a number of good practices in some of the systems in relation to equity in land and

water distribution and rights, incentives, and service delivery in irrigation (box 17).

Corruption³² in irrigation and its effects

There is relatively little research on corruption due to inherent sensitivities and complexities of the issues involved and their legal implications, though one can find an increasing number of reports and articles in the newspapers and magazines based on local-level stories or international-level surveys. According to the Transparency International (TP) 2004, Corruption

Box 17: Some examples of good practices in resource distribution equity, rights, service delivery and incentives for improved system performance

- The de-linked land and water rights system and equity in their distribution in Chinese systems.
- Setting of priorities in water allocation and distribution—with first priority to downstream areas, those in difficult locations in canal commands, and to more vulnerable groups as in Chinese systems.
- Establishing of autonomous irrigation organizations with functions similar to utility companies (i.e., irrigation and drainage authorities and area water boards in Pakistan, irrigation and drainage companies and irrigation enterprises in Vietnam).
- Equity-based water distribution at the local level, providing water first to those at the tail ends. Relatively more investments in downstream areas for improving reliability of water supplies there (Chinese systems).
- Provision of financial incentives to local-level managers for efficient distribution and saving of water (Chinese systems).
- Incentive-based irrigation fee collection methods in Chinese systems.
- Irrigation service provision based on delivery contracts between local-level organizations and service providers (in this case, IDMCs and cooperatives in Vietnamese systems).
- Rotational water supply systems at all levels to ensure equity in sharing water, especially in water-short conditions.
- Formalization of informal water rights, i.e., kacha waranabani to pacca warabandi systems in Pakistan.

³¹a) Equity-based allocation—where water is equitably allocated to all water users along the canal. Water is provided first to those farmers at the canal end and last to those nearest. In our sample, we find 13 percent of villages use this method of water allocation; b) Efficiency-based allocation—where water managers irrigate as water flows in the canal. When the nearest fields are irrigated first, it is physically more efficient to allocate water further. Around 70 percent of villages use this method of allocation; and c) Payment capacity based allocation—which rests on first pay first serve method where managers provide water to those who pay for it first. We found 2 percent of villages operating this way. In the rest 15 percent of villages, there are no established rules for water allocation. In water-short periods, some villages carry out rotational water allocations across villages.

³²Corruption is a matter of perception and involves a great deal of subjectivity. Certain practices may be perceived as corrupt by some, but may not be perceived in the same way by others. Corruption can take many different forms—some material others nonmaterial—and many different ways—some may be more direct and visible, others more indirect and less visible. There may be a multitude of causes of corruption and they would vary from one setting to another. But the most basic causes are lack of clarity in rights, responsibilities, roles and authorities; lack of accountability; lack of adequate incentives; an ineffective justice system; weak policies, laws and institutions and their poor implementation and enforcement—all resulting from overall poor governance.

Perception Index score (CPI, that is based on perceptions of corruption in the public sector, varies from 0 to 10 with 10 indicating highly clean), our study countries are ranked as follows: China (3.4), India (2.8), Vietnam (2.6), Pakistan (2.1), Indonesia (2.0) and Bangladesh (1.5), suggesting a perception of higher degree of corruption in the latter than in the former countries.

Corruption in canal irrigation^{33 34} takes many different forms and continues to be a major problem. In the studied canal irrigation systems in South Asia, our field experiences suggest that corruption occurs in many different ways.

These include corruption in O&M and canal lining works resulting in poor quality of these works, rent seeking by irrigation agency staff, water theft by local elites and influential, tampering of canal outlets, cuts in canals and blockage of distributaries, under-assessment of irrigated areas to reduce revenue to be

Box 18: Does corruption affect canal irrigation system performance and the poor?

The corruption practices influence irrigation performance and the poor in a number of ways i.e., they lead to inadequate funding and maintenance resulting in continuing poor condition and degradation of infrastructure that lowers its service delivery capacity and effective implementation of water distribution rules. These factors, coupled with water theft, lead to increased uncertainty of water supplies, inequities in water distribution, tail-end deprivation and reduced crop productivity – all these factors adversely affect the poor marginal and small farmers, more than the non-poor large farmers, as they have less means to go for alternative sources of water or livelihood opportunities than the non-poor.

Box 19: Is corruption in canal irrigation declining?

Our study in Pakistan shows that while irrigation management reforms have generated benefits including reduced rent seeking by irrigation officials, there are several issues in relation to functioning of newly created local-level organizations. Dominance of local influential people in management committees, nepotism, lack of transparency in spending of O&M funds, lack of involvement/representation of farmers in decision making and information provision to farmers are among the major problems. The management reforms appear to have led to a different set of problems and some relate to corruption; however, it is too early to conclude whether corruption has increased or decreased and whether any changes in corruption are due to reforms or other factors.

While more research is needed in this area, one may expect some reduction in corruption in canal irrigation over the past two decades due to a number of factors: (i) substantial expansion in groundwater irrigation (and conjunctive use of surface water and groundwater) and reduced dependence on canal water as it used to be in the past. For instance, in two of the distributaries studied in Pakistan, Lalian and Khadir, groundwater contributes 55 percent and 89 percent to water use, respectively, providing an important alternate source of water; (ii) and overtime improvements in information on legal systems.

paid to the government, and under-assessment of water charges. These observations are supported by several recent studies. A study in Southern Punjab of Pakistan suggests that asymmetry of information

³³Wade 1982 provides a comprehensive account of various aspects of corruption in canal irrigation in South India that covers the extent of the problem; amount of money involved in corruption from various sources such as from O&M works and related contracts, from irrigators, from sales of posts and transfers; modes of payment; involvement of politicians, irrigation agency officials and staff, contractors and farmers; weakness of accountability mechanisms; effects of corruption on irrigation performance; and possible policy responses (such as using pricing/market tools, enhancing inspections, audits and checks, and involving user organizations in irrigation management). Wade argues that corruption is an important supply-side reason for poor performance of canal-irrigated agriculture.

³⁴See also Rinaudo 2002 and Azam and Rinaudo 2004 for more recent work on corruption in canal-irrigation water in Southern Punjab, Pakistan.

allows rich farmers and the irrigation officials to strike secret deals at the expense of the poorer farmer located downstream (Azam and Rinaudo 2004). Similarly, a study in Andhra Pradesh reported that there was a systematic tendency to underreport the area irrigated during the years preceding the reforms in Andhra Pradesh. “Consequently, less revenue needed to be deposited in the treasury. Water charges in fact were collected from a large area, but found their way into the pockets of the revenue department personnel” (Jairath 1999). Further, Fjeldstad (2003) suggests that the common problem with the delivery of a private service whose production is subject to large fixed costs, such as irrigation, is that bureaucrats charge bribes for delivering the service, and end up behaving like unregulated private monopolists.

Box 20: Does more equity in resource distribution reduce corruption?

Our field experiences and discussions with stakeholders, particularly farmers, indicate that corruption is less where there is greater equity in resource distribution and vice versa. Where there are greater inequities, local elites not only dominate in decision making but also tend to grab an undue share of benefits from public-sector spending/resources.

Recent studies on the subject point to similar conclusions. Bardan and Mookherjee (2002) suggest that while local governments may have better local information and accountability pressure, they may be more vulnerable to capture by local elites, who will then receive a disproportionate share of spending on public goods. They argue that decentralization initiatives are more likely to succeed through reforms that enhance the scope of local democracy and reduce asset inequality.

It is often assumed that decentralized management of resources will improve accountability and governance by bringing the government closer to the people making it easier for the latter to monitor and discipline the state, and hence service delivery will improve and corruption will decline.³⁵ However, there is no conclusive evidence that decentralization reduces corruption. Some studies suggest that decentralization increases accountability and reduces corruption in the public sector. On the other hand, several studies suggest that there are more opportunities for corruption at the local level and that local-level settings are favorable for hiding corrupt practices.³⁶

3.5 Irrigation management reforms

In order to address issues of irrigation-system performance, irrigation management reforms are presently underway in all the study countries. The overall conclusion from the country studies is that the ongoing reforms being promoted such as irrigation management transfer (IMT) and participatory irrigation management (PIM) generated some benefits including for the poor. Grants made to new secondary- or tertiary-level organizations, set up to carry out O&M tasks, have created employment opportunities for landless laborers and marginal and small farmers. The decentralization of management and the increased spending on infrastructural maintenance have improved the reliability of water delivery, especially to the tail ends where poverty is greater. Other social benefits reported during surveys include the reduced theft of water, fewer disputes over water allocation, increased sharing of information among farmers, the empowerment of local communities, and less corruption on the part of irrigation officials.

While the reforms have brought some benefits (tables 3 and 4) including to the poor, they are not sufficient in improving system performance and

³⁵For example, Wade (1982, 1997) suggested that the over-centralized top-down structure system in India is largely responsible for corruption in the irrigation bureaucracy, and proposes that user organizations may be helpful in solving the corruption problem in canal irrigation.

³⁶See Fjeldstad 2003 for recent reviews.

Box 21: Irrigation reform experiences and lessons

The study offers key lessons in relation to implementation effectiveness of irrigation reforms and their implications for the poor:

- Reform implementation progress is slow in Bangladesh, Pakistan and Indonesia.
- New institutional arrangements for management of medium- and large-scale canal systems consist of a three-tier organizational structure in all the systems in the six countries.
- The new institutional framework has been implemented only partially in terms of organizational development at various levels.
- So far, the focus has been on the hardware side with only little attention to the software side of irrigation management.
- O&M grants have provided significant incentives to new organizations (WUAs) to be functional.
- Reforms have led to improved maintenance, increased crop productivity, reduced inequities in water distribution and increased funding, but the full range of impacts remains to be seen.
- The poor have also benefited from reforms, in terms of improved access to water (especially at tail ends), increased system performance, productivity, and employment. But, if not implemented effectively, reforms can be disadvantageous to the poor in the long run.

generating benefits to the poor in a significant way, particularly in South Asian systems. The benefits of reforms appear to be largely due to the rehabilitation assistance/grants provided under the reform interventions, and are of a short-term nature.

The newly created institutions and organizations, especially in South Asian systems studied, have not been sufficiently developed, and there are concerns regarding their long-term sustainability. So far, reforms have been implemented only partially in terms of their spatial scale, (i.e., coverage of systems), organizational structure (i.e., tiers of new management structures) and management functions, (i.e., infrastructural management vs. water management). In the South Asian systems, in particular, focus so far has been on infrastructural development/rehabilitation and maintenance and repair works, with less attention to addressing soft issues, such as developing effective mechanisms for—ensuring equity in water allocations, involving the poor in decision-making processes, negotiating water rights and allocation rules and establishing water rights, especially for the poor, and establishing accountability and incentive systems.

In some countries, notably Bangladesh and Pakistan, respondents voiced concern that the reform process will simply reinforce existing power differences between small-scale and large-scale farmers. And from India came reports the leaders of water user groups were operating more like contractors for water services than farmer representatives. Also, there was a significant gender inequality in decision-making bodies of newly created water user groups.

In general, though, water user groups appeared to be learning their jobs, most of them are “single-issue” groups at present and may need to become multifunctional, with a greater commercial orientation, in the future. The speed of the reform process appeared to influence its success. Reform should be neither too fast nor too slow. In some cases, reforms had been

Table 3: Crop productivity before and after PIM, Andhra Pradesh (kg/ha).

Crop	Prior to PIM (1997-1998)	After PIM (2000-2001)	Remarks
Paddy	4,631	5,557	+926 (due to early transplantation)
Sugarcane	111,150	123,500	+2,470 (due to assured water supply)
Maize	6,300	7,410	+1,235 (due to reliable water supplies)

Table 4: Impacts of improved service delivery in Hakra-4R, Punjab, Pakistan.

Indicator	1998(before transfer)	2002(after transfer)
Water charge (Rs/ha)	175	199
Total revenue collection (Rs million)	4.49	5.40
Water delivery performance*	0.91	1.04
Overall system efficiency**	0.47	0.52
Cropped area (ha)	25,614	2,7115
Head-tail equity	Not available	1.09
Farmers' response on benefits to small and poor farmers		
-increased benefits at the head (%)		40
-increased benefits at the middle (%)		38
-increased benefits at the tail (%)		43
-overall satisfaction (%)		41

* Water delivery performance is defined as the ratio of actual to target volume of water delivered.

** Overall system efficiency is defined as the ratio of annual crop water requirement to the total inflow into the canal system.

more successful on paper than on the ground as in Bangladesh. Also, hasty handover and speedy reforms, as in Andhra Pradesh, tend to deny new institutions the time they need to mature and become sustainable.

Importantly, most reform policies were intended to save the exchequer money and did not contain specific measures intended to alleviate poverty. Making reform more explicitly pro-poor may help secure even better outcomes from reform processes in the future. Irrigation reform should be explicitly recognized and designed as a pro-poor policy in poverty-reduction strategies.

The study findings suggest that irrigation-sector reforms in South Asian systems are likely to be effective in enhancing direct benefits of irrigation to the poor under certain conditions, including equity in land and water distribution, socioeconomic

differentiation among users, levels of agricultural productivity and profitability, and incentives to managers (box 22). Most of these conditions hold for Chinese canal irrigation systems where land and water distribution is fairly equitable, socioeconomic differentiation is relatively less, especially in terms of land distribution, productivity of most irrigated systems is fairly high, and there are incentive systems being established for managers and service providers for improved service delivery. The comparative analysis of traditional collectives and emerging non-collectives in the Chinese systems shows that if managers are provided with positive incentives to earn money by saving water, they improve service delivery and overall water management.

Box 22: How can irrigation reforms benefit the poor?

The study findings suggest that irrigation sector reforms, particularly in South Asian systems, are likely to be effective in enhancing direct benefits of irrigation to the poor where:

- land and irrigation water resources are fairly equitably distributed;
- socioeconomic differentiation among users or groups of users is less, and communities within systems are not very heterogeneous and incompatible (in terms of castes, classes, creeds and power structures);
- benefits of irrigation to farmers are significant and irrigated agriculture is profitable;
- there are incentives for managers and management organizations to improve service delivery; and there is commercial orientation of management institutions, and accountability mechanisms are in place;
- cost of canal irrigation to users is significant and is linked to service delivery, i.e., farmers incur higher irrigation charges, and O&M cost recovery/adequate funding is ensured; and
- irrigation performance is linked to not only overall growth benefits but also to benefits to the poor.

Where such conditions are not favorable, it will take a relatively longer period of time for reform initiatives to be effective for poverty alleviation. Enforcement of strict regulatory measures will remain crucial to avoid adverse impacts on the poor.

Some of these conditions also hold in Vietnam where Irrigation and Drainage Management Companies (IDMCs) have been set up as business entities and are required to be financially self-reliant, that is, to recover their own operating costs through user fees and other

subsidiary income (however, there are issues in relation to their effectiveness as these are owned by the state, but set up as for-profit enterprises). However, in both China and Vietnam, the issue of household land fragmentation (resulting from a policy of “good with bad and near with far” in land allocation to households) may pose some difficulties in effective functioning of water user groups, especially in those settings where scattering of household land plots will require them to be members of more than one user group.

In South Asia, the newly created irrigation management organizations under reforms are yet to mature. They generally lack technical capacity to carry out complex tasks in large systems such as water allocation and have to depend on irrigation departments, that often resist on management transfer to users due to fear of loss of power and authority. The key aspects of management such as establishing of mechanisms for effective accountability, conflict resolution, information-sharing and incentives are generally weak or yet to be strengthened or established in almost all systems studied in India, Pakistan and Bangladesh where the new institutions are just evolving.

On the other hand, the situation is generally better in Chinese systems where such institutions are in a maturing stage. Institutional experimentation and development in Chinese systems offer important learning opportunities for South Asian countries. For example, in order to improve irrigation performance a new incentive system has been introduced for local-level irrigation managers to effectively manage and save water (see box 23).

As a whole, it can be said that China and Vietnam are on one side of the spectrum of the above conditions, Indonesia and India are somewhere in the middle, and Bangladesh and Pakistan are on the other side of the spectrum where inequities in land and water distribution are high, socioeconomic differentiation among water users is significant, inequities in community power structures are huge, productivity of agricultural systems is low, cost of canal irrigation to farmers is also low, and incentives and accountability mechanisms are weak or lacking.

Box 23: Incentives to irrigation managers in Chinese systems

Irrigation water management reform has created a new system of fees, payments and charges that embody the primary incentives for the managers to save water. Water fees collected from farmers include two parts: *basic water fees associated with the fixed quantity of land in the village and volumetric water fees associated with the volume of water use*. Set by water bureau officials, the farmer is required to pay the basic water fee (which is based on his landholdings) and part of the basic water fee belongs to the water manager after it is collected. This part of the manager's compensation is paid to him as a *fixed payment* and provides little or no direct incentives to save water.

The water manager in some communities, in contrast, does have an incentive. In implementing water management reform, Irrigation District (ID) officials agree that the water manager has only to pay the per cubic meter charge for the water that is actually used (*actual quantity*). If the actual quantity of water delivered to the village (at the request of the water manager) is less than the targeted quantity, the difference between the volumetric fee that is collected from the farmers and that which he pays for the water is his *excess profit*. The excess profit is an amount that is earned by the manager beyond the fixed payment.

However, there are sharp differences in the way that villages have implemented the incentives part of the reform packages, regardless of whether they are WUAs or contracting managers. For example, in 2001, on average, leaders in 41 percent of villages offered WUA and contracting (or *non-collective*) managers with incentives that could be expected to induce managers to exert effort to save water in order to earn an excess profit. The critics of water management reforms often point out that one possible adverse consequence of using incentives to induce water reform is that managers may cut back on water deliveries to marginal users, who may also be those on the poorest land.

Our study in China analyzed the implications of incentive-based irrigation management for the poor. The study shows that if managers are provided with positive incentives to earn money by saving water, they improve water management, and water delivered to farmers is significantly reduced with no adverse effects on farmers' output, farm income and poverty. The study recommends that such incentive-based management reforms should be continued and extended in other systems in the country.

3.6 Irrigation service charging and cost recovery

In addition to reforming management institutions, improved cost recovery through irrigation service charging has been identified as one of the core components of irrigation management reforms in the study countries. Improved recovery of at least O&M costs of irrigation is important for improving overall performance of irrigation systems. The poor farmers

and tail enders suffer more where system performance is unsatisfactory (as in most systems in India, Pakistan and Bangladesh) due to poor maintenance resulting from inadequate funding from the public sector or poorly designed irrigation service charging.

The study findings suggest that the benefits derived by farmers from irrigation are generally adequate to enable them to pay for irrigation service charge (ISC) that covers the necessary O&M costs of maintaining the systems for their improved infrastructure and

functioning.³⁷ In most systems, ISC constitutes around 3 percent of the gross value of product (GVP) per ha, with significant variations across systems (0.2 to 7.5%). Similarly, in most systems, ISC constitutes less than 15 percent of average net productivity benefit of irrigation (defined as net value of output from irrigated crop production minus net value of output from nonirrigated crop production), though there are wide variations across systems (1 to 30%). These figures suggest that farmers retain a significant part of benefits derived from irrigation and can afford to pay for ISC.³⁸ Further, subsidies to the sector are usually un-targeted. In settings with high inequities in land and water distribution, a large part of direct benefits of irrigation subsidies accrues to large landholders and the nonpoor, resulting in further widening of the income gap between the poor and the nonpoor.³⁹ Under such conditions, subsidies need to be targeted to the relatively poor areas/systems, and irrigation charges need to be designed in a pro-poor framework.

In India, Pakistan and Bangladesh, there are no direct links between ISC and irrigation service delivery. ISC is levied irrespective of amount of water received, and regardless of full irrigation or partial irrigation, quality and reliability of water supplies, and cost of O&M. The revenue collected through ISC goes to the treasury, and funds for O&M are allocated from annual budgetary allocations. Agencies receiving funds from the treasury have little incentive to spend them efficiently and deliver high-quality service. Also, there are little incentives for water users to demand for improvements in services. Overall, accountability linkages in terms of spending and service delivery between irrigation managers and users remain weak.

Irrigation service charges in most systems, especially in South Asian countries, are set by the provincial/state governments and are generally uniform across canal commands within a province or state, irrespective of the irrigation water delivered to

Table 5: Productivity and irrigation service charging in selected irrigation systems in Asian countries.

Country	SGVP per hectare	Annual ISC per hectare %	ISC as percent of GVP	ISC as % of irrigation benefit	ISC collection rate (%)
Bangladesh	692.5	21.0	5.9	14.5	12.0
India	985.5	10.0	2.7	15.3	45.3
Pakistan	448.5	7.4	2.5	10.0	87.7
China	1661.3	46.5	3.6	10.8	80.0
Vietnam	1577.0	59.5*	5.5	23.5	94.5
Indonesia	1001.8	12.6	0.2 to 4.3	2.5	95.0

SGVP is standardized gross value of product. * This figure is based on the cost of full irrigation (fee for partial irrigation is lower). Irrigation benefit is defined as net value of output from irrigated production minus net value of output from nonirrigated production.

³⁷O&M costs vary across space and time, and depend on a number of factors including infrastructural condition, efficiency in management, and local costs of inputs. Actual, minimum and desired O&M costs may differ significantly. For Pakistani Punjab, O&M cost estimates by Hassan and Khatri (1998) for 1997-98 adjusted to 2001-2002 (using upper bound estimate of 11% increase in costs per year) is Rs. 420.80/ha (or US\$ 6.70/ha), which is equal to the current level of irrigation charge. In India, actual average annual O&M expenditure per ha in Andhra Pradesh was US\$5 in 2001, which was increased from US\$2/ha prior to 2001. Similarly, in four irrigation systems in Java in Indonesia, average O&M expenditure varies from US\$4.5/ha to US\$16.5/ha.

³⁸Past studies also support this conclusion. For example, Small *et al.* (1989) in their case studies in Indonesia, Nepal, Philippines and India suggested that under conditions of a reasonable irrigation service fee, the incremental benefits derived by farmers from irrigation are adequate for them to pay the full O&M cost while retaining a significant increase in net incomes due to irrigation.

³⁹Tsur and Dinar (1995) also suggest that the majority of pricing mechanisms have little potential effect on income distribution when farmers are homogenous, as equity effects of pricing are primarily dependent on land endowments.

Box 24: Irrigation service charging under inequitable land-water distribution—The case of Pakistan

A large part of (in)equities in water distribution depends on (in)equities in land distribution. In systems with fairly equitable land and water distribution (as in China and Vietnam), while the structure of ISC can influence revenues, what is more important for cost recovery is the level of ISC. However, in systems with high inequities in land and water distribution, both the level and the structure of ISC are important for cost recovery and they have implications for the poor small farmers and equity.* This is illustrated using a case study from Pakistan, where inequity in land and water distribution is high and where though ISC level is low its structure is biased towards large landholders. The study analyzed three broad policy scenarios:

- Scenario – 1: Present policy—no change in the structure and level of irrigation charges, charges are based on cropped areas and cropping intensities;
- Scenario – 2: Flat rate policy—flat rate per unit of land based on land size, independent of crop type and cropping intensities, with present average irrigation charge applied uniformly across all farm size categories; and
- Scenario – 3: Differential rate policy—differential rate per unit of land based on land size, applied differentially across various farm-size categories—progressive rate structure (similar to increasing block rate charging). Lower ISC for the first two hectares (subsistence level holding) applied uniformly to all land-size categories, and ISC is increased progressively with increase in size of holdings above 2 hectares, by Rs 50/ha (=US\$0.80) for each successive category of land size.

At the provincial level, under the present charging policy, small farmers in Punjab pay more than large farmers in proportion to the share of each group in total landholdings. That is, small farmers contribute more to total revenues in proportion to their share in total land. This is basically due to differences in cropping intensities, which are higher on smaller-size farms due to greater use of labor and groundwater (which is 9 times expensive than the canal water).** The present policy disfavors the poor, marginal and small farmers. At the provincial level, option – 2 (flat rate charge at present level of average water rate) would result in annual gains for small farmers through reduced costs by Rs 74.45 million (=US\$1.19 million), and cost to larger farmers would increase by Rs 326.77 million (=US\$5.21 million), and total revenues will increase by 5.3 percent. Policy option – 2 is a better option than policy option –1 in terms of equity and revenues. Under policy option – 3, smaller farmers, as a result of reduced costs, would gain annually by Rs 346.88 million (=US\$5.53 million), and larger farmers would contribute more towards costs by Rs 529.76 million (=US\$8.45 million), and overall revenue would increase significantly by 21.8 percent. With policy option – 3, Rs 876 million (=US\$13.97 million) would be redistributed with a significant part in favor of the poor small landholders in Punjab. Major benefits with such a policy change would include: a) more funds available for O&M, with resulting improvements on O&M leading to increased efficiency in irrigation supply and improved system productivity; and b) benefits in terms of reduced costs to small and poor landholders; and more importantly, it would be a step forward to reversing existing inequities in ISC.

* Tsur and Dinar (1995) also rightly suggest that the majority of pricing mechanisms have little potential effect on income distribution when farmers are homogenous, as equity effects of pricing are primarily dependent on land endowments.

** Average cropping intensity varies significantly across farm size categories, with highest cropping intensity of 181 percent on the smallest farm size category and the lowest cropping intensity of 115 percent on the largest farm-size category. Average annual ISC per ha (area weighted) is Rs 421/ha (=US\$6.7). Average per ha ISC is inversely related to land-size categories. Since under the present charging system, crop area that is partially irrigated with canal water and partially with groundwater is fully liable for canal water charges, small farmers are also penalized for making relatively greater use of groundwater. On average, poor farmers incur Rs 56 (=US\$0.79) more in total per ha cost of irrigation than the non-poor, due to greater use of groundwater and resulting higher overall cost.

a canal command⁴⁰ or level of service delivered to farmers or system O&M cost of service delivery. Further, within systems, uniform charges are applied to all locations in a system, and for all socioeconomic groups. On the other hand, the net benefits of irrigation vary widely across systems. Similarly, O&M costs also vary widely across systems depending on age, infrastructural condition, past maintenance of infrastructure, source of water, and efficiency in operations, among others. Moreover, access to water and socioeconomic status/poverty levels varies not only across systems but also across locations (head, tail) within the systems. Under such settings, the application of a single level of ISC at a state or provincial level, though easy to administer, can be disadvantageous to the poor as in certain situations the poor end up subsidizing the nonpoor. Thus, where there are significant differences in benefits of irrigation and poverty levels (as is the case in most South Asian systems), a uniform ISC policy can be antipoor. The differential, as opposed to uniform, charging based on differences in key aspects, such as irrigation benefits, O&M costs, landholding sizes and poverty situation, across and within irrigation systems would be more effective for achieving the dual objectives of cost recovery and benefits to the poor (box 24).

In the studied systems across six countries, annual ISC level varied widely, from US\$4 to US\$67 per hectare. But they were considerably lower in South Asia than in Southeast Asia and China. There are several methods employed for irrigation service charging (such as area-based, crop-based, volumetric at the primary canal level, and multilevel, multipart charging methods). These methods vary in terms of their effectiveness in improving cost recovery and benefits to the poor. Further, the charging methods can be designed such that the dual objectives of improved cost recovery and increased benefits to the poor can be achieved. The multilevel, multipart charging method that combines both volumetric (at higher levels of

canals) and non-volumetric (at lower levels of canals) charging at various levels in a canal system can be effective for improving cost recovery and benefits to the poor farmers. This also fits well with the new tri-level (primary, secondary and tertiary canal levels) organizational structure being developed under ongoing irrigation reforms.

Irrigation charge collection rate is generally higher where private contractors and active WUAs are operating at the local level as they tend to use the carrot-and-stick strategy to improve collection (box 25). In general, collection rates are better where collection bodies are given financial incentives to improve collection rates. The study suggests that strengthening accountability, transparency and efficiency in irrigation management—including in setting, assessment, and collection of irrigation service charges, spending of revenues and system O&M works—is important for improving cost recovery and benefits to the poor farmers.

The following actions could help improve accountability, transparency and efficiency in irrigation financial management:

- a) involving stakeholders, particularly the poor farmers and those from the disadvantaged locations (i.e., tail ends) in financial decision-making processes,
- b) clearly defining roles, responsibilities and authorities for all those involved in irrigation financial management,
- c) establishing transparent service delivery and irrigation service charge contracts,
- d) setting performance targets and standards to be achieved with regular monitoring and evaluations,
- e) establishing formal procedures and arrangements for handling complaints from stakeholders, for auditing budgets, and for addressing issues related to financial mismanagement and corruption,

⁴⁰For example, in Lalian and Khadir systems in Pakistani Punjab, average amount of canal water applied per ha for wheat during rabi season 2001 was estimated at 1458 m³, and 465m³, respectively, (with groundwater contributing 55 % and 89 % of total water applied per ha, respectively) with significant head to tail variations. However, seasonal ISC was uniform in both systems.

Box 25: Irrigation charging can be improved with incentives

In the studied systems in China, irrigation charge collection rate is generally higher where private contractors and WUAs are operating at the local level as they tend to use the carrot-and-stick strategy to improve collection. In some of villages in the systems studied in China, WUAs and private contractors provide water to farmers on a first pay-first serve basis, and in other villages they cut on water delivery to farmers on non-payment of charges. Overall collection rate is higher in the case of private contractors employed for local-level water management.

In the studied systems in Vietnam, local-level cooperatives sign water-delivery water-fee contracts with IDMCs, the cooperatives/members are collectively responsible to collect and pay charges to the IDMC.

There are examples of good practices in incentive based charge collection in other states/countries. For example, in South Gujarat in India, WUAs are given rebate (as much as 50 %) on timely payment of ISC. It is reported that some WUAs collect advance payments from farmers to avail the rebate (Londhe and Kumar 2003).

Similar is the case in some systems in the Philippines where irrigations associations (IAs) are given financial incentive to improve irrigation fee collection to cover O&M costs. The IAs collecting irrigation fee are entitled to receive 2 percent of the collected fee if it was able to collect more than 50 percent of total invoice and receive 15 percent if the collection rate exceeds 90 percent (Fujita *et al.* 2001).

- f) establishing formal mechanisms for awareness raising and information dissemination among stakeholders, especially the poor farmers, and
- g) promoting concept of irrigation as service at the secondary/tertiary levels, and providing incentives to improving efficiency in implementation of the irrigation financial system.

3.7 Micro-irrigation technologies and improved production practices⁴¹

There is a range of irrigation application and resource-conserving technologies, and improved production practices that offer promise for improving productivity and returns to farming by the poor. These include, for example, improved system of water delivery and control (such as targeted lining and water proofing of canals, improved water-control structures), micro-irrigation systems (e.g., such as low-cost micro drips and sprinkler systems), treadle pumps, resource-conserving technologies (e.g., zero tillage, bed planting, laser land leveling), alternate wet and dry method of rice cultivation, system of rice intensification and system of ground cover rice cultivation. While some of these technologies are still being experimented, most have been tested showing significant potential benefits to adopting farmers.

These technologies and improved practices offer a range of benefits including efficiency of water use, crop yields and improved food security (box 27). The potential benefits of these innovative land, crop and water management practices and technologies can only be realized if practically adopted among the spectrum of farmers. Some of the technologies are scale neutral and may even self-select the poor (e.g., treadle pumps, the system of rice intensification). Some of them can be redesigned to make them pro-poor (e.g., micro-irrigation technologies). Some others, such as resource-conservation technologies, can be made pro-poor through efficient institutional

⁴¹ This section is based on a background paper developed for this study by Dr. Namara Regassa of IWMI.

Box 26: Micro-irrigating technologies and improved irrigation and production practices for enhancing returns to farming

The following are examples of innovative practices either under research or being promoted for adoption in Asia:

- *Micro-irrigation systems* - micro-drip, sprinkler systems, treadle pumps
- *Resources conservation technologies or conservation agriculture* - surface seeding, zero tillage with inverted T openers, reduced tillage, etc.
- *The system of rice intensification* - combines soil, water, and weed control
- *Alternate wetting and drying* - an alternative to conventional flooding
- *Aerobic rice cultivation* - low moisture stress tolerant varieties
- *Ground cover rice cultivation system* - covering soil surface with plastic film or plant mulch

arrangements or efficient rental markets for the much needed machinery for their successful adoption. However, there can be constraints to wider dissemination of these systems and technologies. The studies have highlighted several constraints such as organic fertilizer availability, uncertainty of irrigation water supply, crop specificity, complexity, capital intensity, knowledge and technical skills, market access and marketing efficiency.

These technologies bring about completely new dynamics into the farming systems demanding significant changes from the business-as-usual scenario and therefore require high management skills and a learning process by farmers. To further unlock the potential benefits of these innovative systems and technologies the following actions are suggested: a) initial targeted subsidy schemes for the poor for

equitable distribution of the potential benefits; b) targeted training opportunities for the poor to enhance their skills and knowledge so that they can cope with the complexities of the systems; c) encouraging private participation in the supply chain of the needed inputs for the systems (e.g., machines, implements and tools); and d) strengthened public research on the systems for further improvement.

Box 27: Benefits of micro-irrigating technologies and improved irrigation and production practices

Some of the benefits from micro-irrigation technologies and improved production practices are:

- a) they enhance field-level water use efficiency and water productivity, and either significantly improve crop yields or give equal yields relative to the conventional systems or technologies;
- b) some of the systems reduce cost of production due to savings in seed, fertilizers, pesticides, fuel, etc.;
- c) they contribute to household food and nutritional security. This is particularly true for low cost micro-irrigation technologies that enable farm families to grow vegetables, which otherwise was either missing in their normal diet or had to be bought from the market. Further, they have positive human health effects directly through improvements in nutrition and indirectly through effects on the human disease-causing vector population;
- d) they have positive environmental externalities such as reduced pollution of groundwater, reduced greenhouse gas emissions, reduced erosion, etc.;
- e) some of the technologies (e.g., the system of rice intensification) reduce risk to farmers; and
- f) they may spur further investment and employment opportunities in the area.

Box 28: Main lessons and messages

1. *Larger poverty impacts of indirect benefits of canal irrigation*—canal irrigation generates a variety of direct and indirect benefits at the local and broader levels, and the benefits vary greatly across settings. The indirect and broader level benefits of irrigation can be much larger than the direct local-level benefits. Canal systems attract private investments in irrigated agriculture, including groundwater irrigation.
2. *Irrigation reduces more poverty under certain conditions*— the overall poverty in irrigation systems is much less (almost half) than that in their surrounding nonirrigated areas. However, the pro-poor impact of irrigation differs significantly from one setting to another. Despite the overall poverty-reducing nature of irrigation, income poverty persists in most canal irrigation systems. On average, around one-third of households in irrigation systems live in poverty. The extent of benefits to the poor depends on factors such as land distribution, the quality of irrigation management, the availability of inputs and support services, and water and agricultural policies. Irrigation can also have adverse impacts on the poor where negative social, health and environmental dis-benefits of irrigation outweigh the benefits of irrigation to the poor. *Thus, investments in irrigation can be strongly pro-poor, neutral or even anti-poor.*
3. *Past investments in irrigation in South Asia have only partially benefited the poor*—in India, Pakistan and Bangladesh, several influencing factors, notably land equity and irrigation governance and management arrangements, have been unfavorable. Overall, these countries have only partially benefited, in terms of realizing poverty-reducing impacts of irrigation, from past irrigation investments, and there are significant opportunities for increasing benefits of irrigation.
4. *Equity and security in access and rights to resources matter for larger poverty impacts*—where land and water equity exists, irrigation in itself is pro-poor (as in Chinese and Vietnamese systems). Inequity and insecurity in access and rights to land and water are bad for both productivity and poverty.
5. *More poverty in some areas and among some social groups than others*—poverty levels are highest in marginal areas, downstream sites (the “tail”), and areas where canal water is in short supply and the quality of groundwater is poor. Poverty tends to afflict the agricultural dependent landless, female-headed households, as well as households whose farms have low productivity. Income poverty, which may be either chronic or seasonal, tends to be high in areas where irrigation systems perform poorly.
6. *As much as there is gender discrimination, there is also discrimination of minorities and groups along caste and ethnic lines in irrigation*—there are strong linkages between irrigation, gender, diversity and poverty issues. In South Asian systems, poverty is generally higher among female-headed and low-caste/minorities households.
7. *Effective institutions for management, financing, monitoring and accountability matter for irrigation performance.*
8. *While irrigation reforms have generated some benefits, significant benefits to the poor are not visible.*
9. *Unless irrigation reforms are sharpened with a pro-poor focus, the poor are likely to be bypassed*—the irrigation reforms are likely to generate significant outcomes for the poor where land and water are less inequitably distributed; users are socioeconomically less heterogeneous; benefits of irrigation to farmers are significant and irrigated agriculture is profitable; there is strong accountability and incentives in place for improving service delivery; cost of irrigation to users is linked to service delivery; and irrigation performance is linked not only to broader level growth benefits but also to benefits to the poor. Overall, ongoing irrigation reforms are not sufficient in improving irrigation performance and benefits to the poor in a significant way.
10. *Benefits and costs to the poor, and long-term sustainability of irrigation software and hardware should matter in calculus of irrigation investments*—focus only on creating physical facilities and institutions and on their economic performance in terms of aggregate costs and benefits is not sufficient.
11. *Integrated approaches to irrigation interventions generate larger poverty impacts*—no single intervention is sufficient for effective poverty alleviation. Irrigation is one of the important interventions for poverty alleviation along with land, education and roads infrastructure. Further, the poverty-reducing impacts of irrigation-related interventions are larger when they are implemented in an integrated framework
12. *Chinese experiences in resource distribution, institutional, management and technological interventions offer important learning opportunities for South Asia*—as a whole, South Asia has much to learn from experiences in resource distribution, institutional, management and technological interventions, in Southeast and East Asia, particularly China. China and Vietnam have adopted a “distribute first” approach to land (and irrigation water), and rural development as a whole. South Asia, in contrast, has adopted a “grow first” policy in which distributional issues have largely been ignored. As a result, irrigation has not benefited poor people nearly as much as it could have in this subregion. There is considerable scope for reducing poverty in South Asia through land, water, productivity and management interventions.

4. Mainstreaming Pro-poor Interventions in Irrigated Agriculture: Options and Guidelines

The identified pro-poor intervention options and the actions proposed here are based on ground realities, lessons learnt from cross-system and cross-country comparisons of diverse situations, and inputs from a wide range of stakeholders including farmers, NGOs, policymakers, and research and development professionals.

4.1 Getting the fundamentals right

Inequities in resource distribution (land and water) are among the principal causes of rural poverty, particularly in South Asian agricultural systems. High inequities in resource distribution hurt the poor and hinder growth in agricultural productivity. Poverty-reduction strategies and agricultural and water-sector policies often tend to overlook the equity concerns; even where such concerns are recognized, concrete principles, approaches and strategies to reduce them are either absent or not implemented effectively.

Correcting existing resource inequities for poverty reduction by creating an enabling environment: The first and the basic step is to create an enabling environment for poverty reduction through development and strengthening of policies and strategies (specifically related to poverty reduction, land, water and agriculture sector) and linking these policies under a consistent framework. If the commitment to poverty reduction is genuine, then the objective of poverty reduction must drive the process of related policy formulation and institutional development, not the other way round. Clear and concrete policy principles and strategies to reduce inequities should form the foundation of these policies. Further, strategic interventions to reduce poverty must be prioritized on the basis of their impacts on poverty reduction or their potential pro-poorness. However, policy development is one thing,

but its effective implementation is another.

Development of strategies for effective implementation of policies is obviously crucial, and the governments and donors have an important role to play in this area.

Creating permanent assets for the poor: Lack of access to land and water is one of the main causes of poverty in South Asian systems. The poorest of the poor are landless followed closely by the land-poor. Increasing access of the rural poor to these resources and strengthening security of their rights (and improving their quality where the poor already own such assets) would be a *strongly pro-poor* strategy and would create conditions for lifting people out of poverty permanently.

Options for developing and strengthening pro-poor land and water rights: There are a range of options for securing and strengthening access and rights to these resources. Some of these options are more drastic and require hard policy choices and are more difficult under the current sociopolitical scenarios, while others are less drastic and are amenable to policy changes. Table 6 outlines these options with likely impact and feasibility for implementation.



Table 6: Pro-poor options for improving access of the poor to and security of rights to land and water.

<i>Pro-poor options</i>	Likely impact	Implementability
A. More drastic measures		
1. Land - making radical changes in land distribution structure—through ceiling-based regulatory/administrative land reforms for equitable distribution of land (as in China and Vietnam).	High	Difficult to implement under the current sociopolitical scenario
2. Land - improving the access of the poor to land through a combination of ceiling-based administrative and incentive-based market approach, that is, buying lands from large landholders and distributing them to the poor landless and marginal farmers including the poor women farmers, either on a grant basis or on subsidized rates or on long-term leases or through long-term loans to the poor.	High	Difficult to implement under the current sociopolitical scenario and involves high cost of implementation
3. Water - making radical changes in the water distribution structure—redistribution of water in existing systems by separating land and water rights and introducing individual household water rights—de-linking land and water rights.	High	Difficult to implement under the current sociopolitical scenario
B. Less drastic measures		
1. Land - improving access of the poor to land through an incentive-based market approach (sale and purchase on a voluntary basis), with emphasis on provision of subsistence size holding that is economically viable and generate livelihoods sufficient to support an average family.	Significant	Involves significant cost, but can be implemented
2. Land - improving access of the chronic poor to minimum viable land size for subsistence to the poor landless and marginal farmers through redistribution of existing state lands and through purchase of land from large landholders facilitated by NGOs with credit facilities.	Significant	Involves some cost, but can be implemented
3. Water - introducing ceilings on water distribution per household for subsistence size holding and allocating water rights to all households including the landless by partially de-linking land and water rights.	Moderate	Can be implemented, but will require significant changes in policies and laws
C. Modest measures		
1. Land - organizing groups of chronic poor landless and marginal farmers and facilitating access to land on a group basis (e.g., as in Sindh in Pakistan) by involving NGOs; strengthening and reorienting tenancy laws in a pro-poor framework.	Moderate	Can be implemented with only few policy changes and with less cost
2. Water - introducing ceilings on water distribution per household for subsistence size holding and allocating water rights to landholders, with greater security of rights to smallholders.	Moderate	Can be implemented with only few policy changes and with less cost

Specific actions for implementing any of the above options include the following: a) developing a comprehensive database of land and water records by computerizing their records, and identifying landless/chronic poor where local-level NGOs can be involved in the identification process; b) distributing public lands to the landless and chronic poor, providing them the basic-size of holding or a threshold level that generates basic livelihoods, and follow-up with facilitating the development of other infrastructure and improved access to technologies; c) simplifying land-transaction procedures, and encourage development of land markets; d) reducing land tax on basic-size of landholding; and e) strengthening tenancy laws with a pro-poor orientation.

Further, priority needs to be given to smallholder farms for land-quality improvements. Simple measures are often more effective. Raising awareness on land-quality issues and on cost-effective measures to address the problems, such as salinity and waterlogging, through improved irrigation practices, land use patterns and on chemical and biological measures (including pre-sowing irrigation for leaching salts, increasing frequency of irrigations, conjunctive use of surface water and groundwater, micro-irrigation techniques, planting of salt-tolerant crops, rotations in crop cultivation, land leveling, use of gypsum and green manures, testing of land and water quality on a regular basis) through media and through involvement of local NGOs. Newly created organizations, such as local water user groups/associations can also be used as vehicles for dissemination of these technologies and measures.

4.2 Prioritizing geographical areas and socioeconomic groups for rural poverty alleviation

Past approaches to poverty alleviation have often tended to address the problem with one model to fit for all situations, with less account of many specifics of poverty across geographic locations and socioeconomic groups. While recognizing that rural

poverty is a widespread problem in agricultural areas, the study suggests that the magnitude and intensity of poverty vary significantly across locations within and outside irrigation systems, and across socioeconomic groups therein. The study identifies the following locations/groups in terms of differences in poverty:

- Irrigated areas vs. nonirrigated areas
- High productivity irrigation systems vs. marginal or low productivity systems
- Upstream vs. downstream irrigation systems
- Good-quality groundwater vs. poor-quality groundwater areas
- Transient or temporary poor vs. chronic or permanent poor
- Land-rich/Land-poor vs. landless
- Male-headed households vs. female-headed households
- High-caste/majorities vs. low-caste/minorities

Poverty is generally more and deeper in the latter than in the former locations/groups. The differences in poverty situation across these locations and groups suggest that: a) poverty alleviation efforts need to be prioritized according to its magnitude and intensity, and



b) separate models tailored to specific situations would be more effective in alleviating poverty. The latter locations and groups need long-term interventions through the development of resources/infrastructure to improve the average incomes while the former locations/groups need interventions that help maintain already higher average incomes. Also, the latter locations/groups call for relatively greater investments than the former; but the impacts on poverty alleviation of such investments will be much more in the latter than in the former. Further, for the latter, the public sector should play a role at least in the initial stages, while for the former groups/areas, the private-sector role including that of NGOs should be promoted.

4.3 Distinguishing between irrigation water as a “resource” versus “service”—pro-poor approaches to management and service delivery

Irrigation water is often viewed as a resource and the public sector role is considered important. It may be useful to distinguish irrigation as a resource and as a service. At the higher levels (dam, basin, primary canals) irrigation water can be considered as a resource, with positive and negative externalities associated with its uses and allocations, requiring some interventions from the public sector in its management and allocation. However, at the lower level (e.g., secondary, tertiary levels) irrigation can be considered as a service to users, requiring role of service providers in effectively delivering services. This distinction can help identify interventions at various levels.

Irrigation water as a resource: pro-poor interventions

In the South Asian systems, poverty is found to be relatively higher in areas where access to canal water is less, and groundwater is either not available or not developed or is of marginal quality or unfit for cultivation. Separate strategies are needed for each of these situations, some call for development of groundwater, others call for canal water reallocations and yet others call for conjunctive use of surface water

Box 29: Specific interventions for enhancing benefits of irrigation resource to the poor

- a) develop groundwater zones based on its availability and quality;
- b) develop strategies for reallocation of canal water to areas/communities where access to good-quality groundwater is less or groundwater is only marginally fit but still useable for irrigation, and do canal lining in selected areas;
- c) promote conjunctive use of surface water and groundwater; and
- d) provide targeted subsidies for the poor areas and communities where groundwater can be developed.

and groundwater. Canal water management, planning and allocation at higher levels should account for availability and access to groundwater in order to enhance antipoverty impacts of canal irrigation, and that is feasible only when these two sources of water are jointly managed. In canal water allocations, priority should be given to disadvantaged and downstream areas and communities, especially in areas where communities depend largely on agriculture for their livelihoods, and other sources of water (such as groundwater) are limited or absent by specifying and effectively enforcing water rights. This may require relatively more investments in the downstream areas in order to improve reliability of water supplies there.

Irrigation as a service: pro-poor interventions

At the lower levels of the canal network, irrigation should be considered as a service to users. Past approaches to irrigation, particularly in India, Pakistan and Bangladesh, are characterized by lack of commercial orientation, weak or no incentives to service providing agencies, absence of accountability and effective regulatory backup. There is a need for reorienting irrigation service delivery with commercial principles

and incentives, with enhanced accountability and regulatory backup. Improvements in these four areas should form the core of new institutional arrangements for service delivery in the sector.

Setting performance standards and poverty-alleviation targets in irrigation systems: Irrigation-system performance and service delivery must be guided by performance standards and poverty-alleviation targets, and not the other way round. Irrigation service providers and/or water user organizations should be required to meet certain standards in terms of infrastructural maintenance, financial self-sufficiency, equity in water allocation and distribution, water use efficiency and productivity, environmental sustainability and poverty alleviation by setting clear and realistic standards through regular performance assessments and monitoring of each system. While effective regulations may be necessary, providing financial incentives to managers/management organizations will be important for effective implementation of this approach.

Pro-poor institutional arrangements: The weak institutional arrangements and inadequate funding are among the main causes of poor irrigation performance in medium and large-scale canal irrigation systems. In the ongoing reforms, priority should be given to: a) creating conditions for reforms in South Asian countries (particularly in Pakistan and Bangladesh); b) replicating and up-scaling recent reform initiatives; c) expanding the coverage of newly created tertiary-level organizations/water user groups in terms of their functions, such as water distribution, in addition to physical infrastructural maintenance works; d) strengthening or establishing of the second and third tiers of new organizational structures, which either do not exist or weak in most cases, of the three-tier reform model; and e) importantly, developing strategies for sustainability of organizations (e.g., making WUAs multifunctional with a commercial orientation).

Box 30: Specific interventions for creating pro-poor irrigation institutions

- a) involve the poor men and women in water management decisions in newly created organizations/WUAs with greater representation of the poor and smallholders and those from disadvantaged locations (such as tail ends), along with their capacity development through training and information-sharing programs;
- b) establish and empower WUAs of tail enders;
- c) ensure greater representation of users from disadvantaged/tail locations in secondary and primary levels of organizations;
- d) create incentives for farmers to joining WUAs/FOs (for example, by charging different irrigation rates to organizations and individuals, with higher rates applied to nonmember individuals and lower rates to members of WUAs/FOs); and
- e) charging differential rates to WUAs across and within systems, where higher irrigation charges may be justified where WUAs have stronger economies and derive relatively larger benefits from irrigation use, and vice versa.

Pro-poor water distribution and service delivery

Unlike in the past, water distribution methods and service delivery at the secondary and tertiary levels need to be designed with explicit benefits to the poor. Specific measures in this regard include the following: a) prioritizing tail ends for water distribution; b) prioritizing the poor smallholders, by distributing more canal water per unit of area for smallholders compared to large landholders. While this may be difficult to implement unless drastic measures are taken to revise water rights in favor of smallholders, this may be realized by allocating more water to those distributaries or minors where there is a larger number of smallholders or where there is relatively greater equity in land distribution; c) adopting rotational canal

water distribution across distributaries and minors during dry seasons and periods of water scarcity, and prioritizing protection of minimum water flows for smallholders in drought and scarcity conditions to ensure household food security; d) establishing written irrigation service delivery contracts between service providers and users including the poor men and women users; e) compensating poor users in case of the failure of the service providers to deliver water to them as per agreed contracts; and e) providing financial incentives to service providers for enhancing irrigation benefits to the poor men and women.

4.4 Decentralized financial autonomy of irrigation service with pro-poor charging methods

As mentioned earlier, the lack of effective decentralized institutional arrangements and inadequate funding are among the main causes of poor irrigation performance in medium and large-scale canal irrigation systems. In the South Asian systems, there are no direct links between irrigation service charging and service delivery. The revenues collected through charging go directly to the treasury and O&M funds are allocated from annual budgetary allocations that are often inadequate or spent inefficiently. As a result, incentives and accountability linkages between users and agencies are weak. Further, irrigation service charges are set by the provincial/state governments and are usually uniform across canal commands and locations within canal commands, irrespective of the amount of water delivered and the quality of service. The application of uniform charging does not reflect local O&M costs, benefits derived from irrigation, and poverty situation. In settings with high inequities in land and water distribution, low level of charges applied uniformly to all socioeconomic groups of water users disadvantage the poor, who suffer the most from the poor system performance. In certain situations, the poor end up subsidizing the nonpoor. The decentralized financial autonomy with improved recovery of at least O&M cost is important for improved irrigation performance and service delivery. The study suggests that

the average benefits derived by farmers from irrigation are generally adequate to enable them to pay for service charges that cover the necessary O&M costs.

The study offers a range of options for designing and implementing a service charging systems for improved cost recovery with greater benefits for the poor. The following are some of the suggested specific actions and interventions: a) decentralizing irrigation financing arrangements with financial autonomy to newly created organizations, and targeting subsidies to the poorer areas; b) linking irrigation service charging to service delivery, O&M costs and benefits of irrigation; c) establishing formal written service delivery and service charging contracts; d) establishing different charge rates for each system and locations with systems (head, tail) according to level of service delivery, O&M costs, benefits derived from irrigation and poverty situation; e) establishing multilevel-multipart charging methods (i.e., volumetric charging at primary and secondary levels where water can be measured with basic flat rate per hectare of command area irrigated and a flat or variable rate per unit of water delivered; non-volumetric charging at tertiary/WUA level with area-based or crop-based charging (e.g., a variable rate per hectare across seasons, different rates for dry and wet seasons, but flat rate per hectare of farm for all crops grown in a season regardless of farm size. A flat rate per hectare applied to land size for subsistence, and differential rate applied beyond subsistence level with progressive rate structure regardless of farm size—with control on farm total water supplies through defined entitlement/right per hectare of farm); f) introducing a system of advance payments in part or full with financial incentives where feasible; g) offering financial incentives to service providers for i) effectively implementing irrigation financing including service charge assessment, collection, spending with appropriate regulation, transparency and accountability mechanisms built-in; and ii) meeting or exceeding irrigation performance standards, and dual objectives of improved cost recovery and increased benefits to the poor.

Further, the study identifies twelve important components of ISC based on the lessons learnt in this study, and outlines a number of options and good

practices for each of the components for designing and implementing effective irrigation service charging methods that lead to improved cost recovery and benefits to the poor (box 31 and appendix table). The likely impact of each of the identified options in terms of cost recovery, benefits to the poor and ease of implementation are also indicated. We hope these options would be useful to the donors and government irrigation policymakers, planners and managers in developing countries of the region.

4.5 Other pro-poor measures for redistribution of irrigation benefit

In settings with highly inequitable land and water distribution and inequities in benefits of irrigation, there is a need to adopt measures that lead to enhanced benefits of irrigation to the poor men and women. Apart from introducing differential charging for irrigation service across more productive and less productive systems and locations within the systems (advantaged vs. disadvantaged) and across large and small farmers, other interventions can also be considered for redistribution of benefits in favor of the poor (box 32).

4.6 Pro-poor approaches to enhancing productivity the value of water

Increasing productivity and the value of water in ways that favor the poor farmers. This can be done through targeting systems with the poor small farmers for promoting: a) diversification of cropping patterns towards less water-consuming high-value crops (e.g., high-value cash crops, horticultural crops) and other high-value agricultural enterprises (e.g., livestock, poultry, fisheries); b) the use of improved cultivation methods and resource-conserving technologies (e.g., bed and furrow method, zero tillage technology, precision irrigation, precision land leveling, and land-quality improvement measures); and c) and improved access to key production inputs, and support services including agricultural extension and market-related information to the poor.

Box 31: Essential components (and options) for designing irrigation financing systems to meet the dual objectives of improved cost recovery and increased benefits to the poor

The study identifies the following twelve essential components and options for designing an effective irrigation financing system:

- *Irrigation financing arrangements* centralized vs. decentralized with or without dependence on public funds/subsidies.
- *Irrigation institutions for managing irrigation finance*—public-sector agencies or autonomous bodies.
- *Structure of irrigation service charging* - area-based, crop-based, volumetric, multilevel-multipart charging.
- *Level of service charge* - service charge linked to O&M costs, service delivery, or benefits derived from irrigation use.
- *Uniform or differential charging across settings, systems and locations within systems.*
- *Service delivery and irrigation charge contracts.*
- *Arrangements for irrigation service charge assessments, collection and spending* - public-sector agencies, WUAs/FWUAs or private sector/third party.
- *Irrigation service charge collection/payment* - after harvest, partial or full payment in advance.
- *Mode of payment* - in kind or cash.
- *Incentives to farmers for paying irrigation service charge* - financial, regulatory.
- *Incentives to managers for effectively implementing irrigation service charge system.*
- *Incentives to managers and service providers for improving overall system performance, and achieving the dual objectives of cost recovery and increased benefits to the poor.*

(see appendix table for more details on these components, options and their likely impacts for cost recovery and benefits to the poor).

Box 32: Other specific measures for redistribution of irrigation benefits to the poor

- a) collect contribution for initial capital cost recovery or replacement capital cost recovery from advantaged areas and large farmers;
- b) spend more for irrigation/infrastructural performance improvement in disadvantaged areas through targeted subsidies or through cross-subsidization in favor of the disadvantaged areas;
- c) ensure compensation to smallholders for failure of service providers to deliver water to them;
- d) promote labor-intensive methods of construction and rehabilitation of irrigation for increased employment for the poor;
- e) promote labor-intensive methods of production in new or rehabilitated systems;
- f) involve the poor in irrigation O&M activities, monitoring and supervisory roles; and
- g) involve the poor in irrigation service charge assessment, collection and spending activities.

Crop and farm-enterprise diversification is relatively more labor-intensive than specialized farming; therefore, promoting crop diversification will not only lead to enhancing the value of water but also resulting in greater employment opportunities for the poor with pro-poor outcomes. Development of effective mechanisms and institutional arrangements that lead to widening of access, with low transaction cost, by small farmers to the support services, should be an important strategy for enhancing the value of irrigation water to the poor. Delivery of these services in an integrated manner with public-private-sector partnerships (such as emerging Agri-malls in Pakistan, emerging farmer companies in Sri Lanka), and potential use of WUAs as vehicles for service delivery are important options that can be pursued and further explored.

4.7 Adopting integrated approaches to investments, management and service delivery in agriculture for enhancing benefits to the poor

The study findings suggest that the poverty-reducing impacts of interventions in irrigated agriculture are larger when they are implemented in an integrated framework. We identify five specific areas where integrated approaches can generate larger poverty reducing outcomes, as given in box 33.

Box 33: Specific areas for integrating interventions

- Integrating investments in irrigation infrastructural development/rehabilitation with investments in irrigation management improvements (improvements in institutional arrangements, service delivery and water allocation/distribution).
- Integrating development/rehabilitation of irrigation systems/infrastructure with additional development that allows multiple uses of irrigation water, including for water uses for domestic purposes and small-scale enterprises that contribute to livelihoods of the poor landless and smallholders.
- Adopting integrated approaches to management of canal water and groundwater.
- Adopting integrated approaches to service delivery in agriculture (i.e., provision of inputs, technologies, information, finance, marketing).
- Adopting integrated approaches to assessing impacts of irrigation-related interventions such as socioeconomic/poverty, health and environmental impacts, and identifying interventions for enhancing positive impacts and minimizing negative impacts.

4.8 Pro-poor approaches to project feasibility study, project design, implementation, monitoring and impact assessments

Irrigation project appraisals, project selection, design and evaluation typically center on the establishment of physical facilities and institutions/ organizations, economic and financial performance in terms of aggregate costs and benefits, with little or no attention to poverty implications, follow-up plans and longer-term sustainability of the new infrastructure and organizations created. There is need to factor in poverty reduction impacts of interventions in both *ex ante* and *ex post* evaluations and cost-benefit analyses.

4.9 Pro-poor approaches to capacity development and empowerment (C&E):

Capacity development and empowerment efforts should focus on creating awareness on water and poverty issues, and disseminating pro-poor best practices at the higher and the local level through involvement of media and other effective means of information. C&E efforts should also focus on development of new skills and enhanced ability of the poor men and women to participate in decision-making processes in irrigation management, and on the creation of opportunities for them to use the new skills, and creation of livelihoods and employment opportunities for the poor. Efforts should focus on regular updating of policymakers, creating new water leaders, especially from among the poor men, women and disadvantaged minorities, empowering of local-level leaders, managers and farmer representatives. Some of the simple, but effective, actions include disseminating policy briefs on water and poverty to policymakers; briefing of media personnel; disseminating best pro-poor practices at the local level in local languages through the media; initiating programs such as organizing information-dissemination days/farmers-days in poor communities; and introducing and

promoting curricula on water and poverty in colleges and universities.

4.10. Developing and strengthening the knowledge and information base on water, productivity and poverty

Research and development on water, productivity and poverty issues in agriculture are important for developing the knowledge base and identifying the best practices to address these issues. Action-research-based identification, analyses and promotion of pro-poor approaches, interventions and better practices should take priority on the knowledge-development, information base and dissemination agenda. This study identifies a number of major issues and priority areas for interventions and for further actions and research (box 34). Further, efforts should also be put to effective dissemination and use of knowledge, through involvement of key stakeholders at global, regional, national and community levels. Institutionalizing the development of operational packages of knowledge and technologies, and establishing effective dissemination mechanisms for timely delivery of such packages at various levels should be an important strategy. International donors can play an important role in facilitating such initiatives.



Box 34: Key country-specific areas for interventions

China: developing and promoting water-saving and -conservation measures, technologies and institutional innovations for increasing water use efficiency to address the problem of increasing water scarcity and competition across sectors.

Vietnam: developing and promoting measures to enhance the economic value of agricultural productivity through agricultural enterprise diversification; and developing approaches to further strengthening and integrating management institutions at various levels.

Indonesia: developing and promoting approaches to enhancing the economic value of agricultural productivity through crop and enterprise diversification and by strengthening farm to market linkages.

India: developing and promoting approaches to enhancing both physical and economic productivity, developing strategies for expanding reforms and strengthening the newly created FOs for their long-term sustainability, and expanding geographic, hierarchical and functional coverage.

Bangladesh and Pakistan: developing strategies for correcting prevailing inequities in resource distribution and opportunities, and creating conducive conditions for enhancing both physical and economic productivity in agriculture and for effective implementation of institutional reforms in the irrigation sector.

4.11. Guidelines for moving forward

The study findings suggest a number of guidelines that should be of use to policymakers, donor agencies and others involved in irrigation and agricultural projects. These are summarized as follows.

1. *Select irrigation and related projects/interventions based on the “strongly pro-poor” criterion as suggested in generic typology of interventions developed in this study (i.e., strongly pro-poor, pro-poor, neutral, anti-poor).* From the outset, development and donor agencies should actively incorporate equity and poverty-alleviation objectives and principles into the irrigation projects they design, fund and execute. Indeed, the potential to alleviate poverty should be the main criterion of selection for irrigation-related projects. But it should be remembered that irrigation alone would not be a complete antidote to rural poverty in Asia, as other complementary measures are also needed.
2. *Make poverty impact assessments as the first step in designing, implementing, monitoring and evaluating projects and interventions.* Poverty assessments, as well as analysis of associated constraints and opportunities for poverty alleviation, should be undertaken at the project appraisal and design stages. An explicitly pro-poor approach implies systematic identification and targeting of poor communities and disadvantaged subgroups for new investments. Projects should be tailored to respond to local causes and conditions of poverty. No single intervention model fits all situations. The costs and benefits to the poor (as well as to the environment) should likewise be key factors considered by project monitors and evaluators.
3. *Use the generic typology of benefits and dis-benefits developed in this study to incorporate all forms of direct and indirect (dis)-benefits of irrigation.* Irrigation project appraisals and evaluations need to take into account all types of direct and indirect benefits and dis-benefits of irrigation as identified in this study. Since various types of irrigation benefits and dis-benefits influence different socioeconomic

groups differently, separate strategies and interventions can be designed to enhance particular types of benefits for a particular socioeconomic group. Similarly, in designing irrigation policies and management interventions, the various types of irrigation benefits and dis-benefits, and beneficiaries and those adversely affected should be explicitly taken into account in order to devise effective strategies for enhancing net benefits of irrigation to particular groups of beneficiaries. The typology of benefits of irrigation developed in this study could provide a useful tool for donors, irrigation policymakers, planners and researchers engaged in understanding and designing interventions for improving benefits of irrigation, particularly to the poor.

4. *Make irrigated agricultural investment packages for hardware and software development more comprehensive, with emphasis on integrated approaches to interventions and public-private partnerships.* Investment packages for irrigated agriculture should go beyond irrigation per se. Other support services and inputs (including information and technology) that help farmers diversify both crop and non-crop production should be included, and provided through integrated approaches. Public-private partnerships can be important vehicles for delivering these resources at prices the poor can afford. The following are some of the specific areas of interventions:
 - a) Develop canal irrigation investment packages such that infrastructure development or rehabilitation goes together with improvements in irrigation management and service delivery and improvements in water allocation/distribution rules.
 - b) Develop canal irrigation investment packages for improvements in infrastructure and management such that the systems allow multiple uses of irrigation water.
 - c) Develop canal-irrigation investment packages that lead to joint management of surface water and groundwater.

- d) Together with integrated approaches to investments and management of irrigation, promote integrated approaches to service delivery in agriculture (i.e., provision of inputs, technologies, information, finance, marketing) by promoting and facilitating private-sector investments (with initial financial support to the private sector/NGOs and regulatory backup).
 - e) Adopt integrated approaches to evaluating and assessing impacts of irrigation-related interventions such as socioeconomic/poverty, health and environmental impacts, and identifying interventions for enhancing positive impacts and minimizing negative impacts.
5. *Prioritize and target support to the poor.* Support to the poor should be prioritized and targeted to the poor areas, communities or groups according to poverty levels. This can be done in a number of ways:
 - a) Recognize and prioritize support to the poor in policies, laws and institutional arrangements. For example, incorporate land and irrigation access and rights for the poor in poverty-reduction strategies (e.g., PRSPs), and incorporate related poverty-reduction components into land and irrigation policies and strategies.
 - b) Prioritize investments in areas, irrigation systems or parts of systems with greater poverty, and for uses of water that benefit the poor more than the nonpoor.
 - c) Prioritize technology access and institutional support in areas, irrigation systems or parts of systems with greater poverty.
 - d) Ensure greater representation of the poor in newly created organizations at all levels (WUAs, FWUAs) with clear objectives of making them pro-poor.
 - e) Promote local-level irrigation financial autonomy with emphasis on differential irrigation service charging and spending across systems and parts of large systems by designing charging systems that meet dual objectives of cost recovery for

improved system maintenance and enhanced benefits to the poor.

- f) Introduce accountability and incentive systems by offering incentives to irrigation managers and service providers, including financial incentives, for providing greater benefits to the poor and disadvantaged groups and locations.
- g) Empower the poor through providing targeted training, information-sharing and awareness-raising for the poor.
- h) Enhance support to reputed NGOs and organizations established with public-private partnerships that are exclusively working on innovative initiatives for poverty alleviation, and replicating models of such NGOs within and across countries in the region. A recently created organization, the Pakistan Poverty Alleviation Fund (PPAF) is a good example of such partnerships effectively working for the poor.

6. *Recognize both gender and diversity aspects as critical to enhancing benefits of irrigation investments to the poor.* Gender and diversity issues are critical in irrigation management that aims to address poverty issues. It is important that poor women and dis-advantaged/low-caste people and those belonging to minorities are involved in the design of irrigation interventions and their implementation. They should also be actively involved in the decision-making processes of water user groups, in line with sociocultural practices. Considering various constraints that women face, especially in male farming systems of India, Pakistan and Bangladesh, an effective strategy for enhancing women participation would be to create separate local groups of women who can be represented through women group leaders or women extension workers in meetings at WUA and higher levels. Awareness raising, capacity building through training programs for women by the women and enhancing their literacy levels would help in empowering women. Further, women, and particularly those from female-headed households and those belonging to a low social hierarchy, should be given priority in: a) creating

physical assets and securing land and water rights, b) improving their access to inputs and services, involving in irrigation management institutions with their greater representation; and c) developing/rehabilitating irrigation infrastructural facilities that allow multiple uses of water.

- 7. *Adopt a sequenced approach in irrigation reforms using a multilevel framework offered by the study, and prioritize geographical locations for interventions with separate models designed according to local conditions.* In South Asia, irrigation reform progress is slow and there is a need to move forward with reforms with an explicit pro-poor focus, while addressing issues related to low agricultural productivity and profitability and equity in land and water distribution and rights. For meaningful implementation and significant impacts, it is important to start with interventions at the macro level in relation to the contextual factors identified in the study for correcting fundamentals and creating an enabling environment—through suggested changes in policies, laws and institutional arrangements. This should be followed by meso-level interventions including proposed changes in procedures and practices at the management level, followed by interventions for addressing micro- or local-level issues. For local-level reform implementation, it is important to differentiate and prioritize geographical locations according to underlying conditions and socioeconomic compatibilities of water user groups. The reform models should be designed according to local conditions, and the “one model fit for all situations” approach should be avoided.
- 8. *Distinguish between irrigation as a “resource” and as a “service.”* Irrigation should be considered as a natural resource that has both positive and negative externalities (at the higher national or basin levels) as well as a service to end users at the lower levels. The former concept requires some form of public-sector intervention in the management of the resource, the latter requires emphasis of delivery of quality services. The service aspect of irrigation requires

promoting service-delivery contracts between service providers and the users with due attention to the users who are poor and those at disadvantaged locations. Irrigation-service delivery can be improved with decentralized financial autonomy that leads to improved cost recovery (of at least O&M costs) and efficient spending of revenues.

9. *For addressing difficult issues in land and water equity and rights, start with proposed modest measures.* There are a number of pro-poor options as identified in this study for improving equity in land and water distribution (particularly in South Asian countries), and improving security of rights and access to land and irrigation water for the poor, with varying degrees of impacts on poverty. These options offer opportunities for designing pro-poor interventions according to local sociopolitical and poverty situations. From the menu of proposed options on land and water distribution and rights, start with more modest measures with the aim to moving to measures that generate large outcomes for poverty reduction.
10. *Promote other pro-poor measures that lead to redistribution of irrigation benefits to the poor, by incorporating them in new water policies and laws, guidelines to irrigation managers and service providers, and new laws and procedures being established for newly created organizations (e.g., WUAs) under reforms.* In addition to pro-poor interventions that lead to redistribution of rights to resources, other interventions that lead to pro-poor redistribution of benefits from these resources should also be promoted. These include, for example, differential irrigation service charging, recovery of initial capital cost or replacement cost from advantaged areas and large farmers, ensuring compensation to smallholders for failure of service providers to deliver water to them, promoting labor-intensive methods of construction and rehabilitation of irrigation for increased employment for the poor; promoting labor-intensive methods of production in new or rehabilitated systems; involving the poor in irrigation O&M activities, monitoring and supervisory roles and involving the poor in irrigation

service charge assessment, collection and spending activities. Ongoing reforms provide an important entry point for promoting these proposed pro-poor measures, by incorporating them into the new irrigation/water policies and laws, guidelines to irrigation managers and service providers, new rules, regulations and laws being established for WUAs and higher canal-level organizations. Further, it is important to look into various irrigation interventions to fully understand the issue of cross-subsidization (e.g., through irrigation service charges, water allocation, contribution to O&M) that such interventions may lead to, in terms of, *who subsidizes whom*, and take measures to make subsidization in favor of the poor.

11. *Make new institutional arrangements for monitoring and enhancing benefits of irrigated agriculture to the poor.* Irrigation projects and their pro-poor impacts must be sustained long after the implementation phase has ended. In this regard, sustainability issues need to be emphasized and dealt with at the design stage of interventions. Likewise, mechanisms for monitoring, assessing and enhancing benefits and reducing costs to the poor should be developed with the long term in mind. There is a need to establish a new institution/body for designing strategies for monitoring, evaluating and enhancing net benefits to the poor, particularly in India, Pakistan and Bangladesh. The indicators, frameworks and menu of interventions developed in this study can provide an important foundation for designing such mechanisms and strategies.
12. *Promote adaptive learning and action research.* The successful implementation of projects, whether they relate to new infrastructure or institutional reform, depends on adaptive learning and action research, which should be emphasized in implementing interventions. It is suggested to develop and implement a pilot-action research project on implementing the pro-poor intervention framework developed in this study in order to field-test the proposed interventions.

13. *Strengthen the local-level knowledge base on poverty.* The knowledge base on poverty at small geographical scales (such as the subdistrict or irrigation-system level) is weak and sometimes flawed. It needs to be strengthened. Donors, in partnership with national agencies and NGOs, could help create poverty maps and indicators for use at local scales.
14. *Facilitate development of partnerships.* Last but not least, the vital role of public institutions in fighting poverty must not be forgotten. Governments

continue to serve as major initiators, regulators and facilitators in the implementation of pro-poor interventions, including those in irrigated agriculture. However, they cannot be expected to be all things to all people. Public agencies should forge strong partnerships with the private sector, NGOs and poor communities. Each one of these partners has its own comparative advantage, and each partner can make unique contributions to fighting poverty (box 35).

Box 35: The way forward, building effective partnerships

Each one of the partners has its own comparative advantage. Below are some of the key areas where each partner can make contributions, with the objective of improving irrigated agriculture for immediate enhanced antipoverty impacts of irrigation.

Poor Communities

- Participating and contributing
- Adopting innovation, technologies
- Making private investments

Service Providers and R&D NGOs

- Delivering service
- Disseminating information, knowledge
- Promoting technology and innovations
- Mobilizing communities

Governments

- Undertaking policy reforms
- Building institutions
- Implementing policies, regulations
- Making investments

Donors

Making investments in:

- Infrastructure, institution building and policy development
- R&D, technology and innovations
- Developing partnerships
- Promoting best practices



5. Issues for Further Action and Research

This study has answered several specific research questions. However, many new questions have arisen. The study has identified several areas for further actions and research on irrigation and poverty linkages, and has highlighted the critical need to continue efforts for effectively addressing issues related to irrigation and poverty reduction. Some of the key issues are summarized as follows:

1. *Widely sharing and disseminating the lessons, pro-poor intervention options and guidelines of this study.* A proposal may be submitted for initiating second phase of this project for ADB's consideration for financial support.
2. *Developing pilot projects for testing and demonstrating the impacts of proposed pro-poor interventions.* It is proposed to develop and implement pilot-action research projects in three countries for implementing the pro-poor intervention framework developed in this study in order to field-test the proposed interventions—including pro-poor interventions related to land and water rights, pro-poor water distribution, pro-poor irrigation management institutions, pro-poor charging methods for improved cost recovery, pro-poor technologies, integrated approaches to investments in infrastructure, irrigation management and service delivery in irrigation, and pro-poor approaches to improving productivity in irrigated agricultural systems.
3. *Understanding water-poverty linkages at macro-economy level in the context of the ongoing broader level of economic reforms related to market distortions (prices, subsidies and taxes).* While the study has covered micro, meso and macro levels of the economies in relation to irrigation and poverty linkages, much focus has been on the micro and meso levels and less on the macro level. Further research is suggested on understanding water and poverty linkages at the macro economy level. This is particularly important in the context of ongoing broader economic reforms that aim to remove market

distortions. Under the reforms, the price supports and input subsidies have been/or are being gradually phased out to align domestic prices with international markets. This is happening at times when further growth in productivity is slowing down, partly due to a lull in innovation in production technology. The effects in terms of increased cost of production from removal of subsidies, and slowdown in productivity could adversely affect returns to producers, particularly to the poor. However, it is not clear how such changes influence effectiveness of water-sector investments, performance of irrigated agricultural systems, and what will be their implications for poverty alleviation. More research is needed in this area to answer the following questions: a) what are the impacts of phasing out of input subsidies/support prices (under economic reforms) on benefits of agricultural water, and overall returns to investments in the water sector? b) with phasing out of subsidies, are the benefits of irrigation declining compared with the initial stream of benefits generated with input subsidies/support prices? c) how are such changes influencing the level of input use, cropping patterns and productivity, profitability of producers, and most importantly, how poor farmers have been/are being affected from these changes? d) what are the implications of these changes for poverty alleviation? The answers to these questions will help develop further understanding of the impacts of recent broader-level economic reforms and help develop strategic interventions that are necessary to enhance benefits of past and future investments in irrigation for their effective contribution to poverty alleviation.

4. *Understanding mechanisms for promoting best practices in service delivery in irrigated agriculture.* The review of international best practices in service delivery indicates that the effective initiatives are those that a) embrace a partnership approach; b) integrate a number of different services under the same roof, or through joint-operating procedures; c) demonstrate innovative solutions for commonly recognized problems; and d) can be transferred to other localities and cultures. The concept of

integrated-services provision (ISP) in the agriculture sector, through public-private-sector partnerships, has not been promoted as an alternative to public-sector provision of these services. However, over time, various ISP type experiments have been carried out or similar ideas and initiatives have emerged spontaneously, though mostly at a smaller scale. The review of various case studies and examples of various models, initiatives and practices from Pakistan, India, Sri Lanka, China, sub-Saharan African countries and other countries, provide indications that farmers' access to these factors and services can be improved through their provision in an integrated manner with public-private-sector partnerships. Further, one might also explore the option of using WUAs as vehicles for delivery of key inputs and services. However, in order to recommend an effective approach to service delivery in agriculture in the study countries, more in-depth research is needed on various initiatives and models, their functioning, institutional arrangements and their successes and failures.

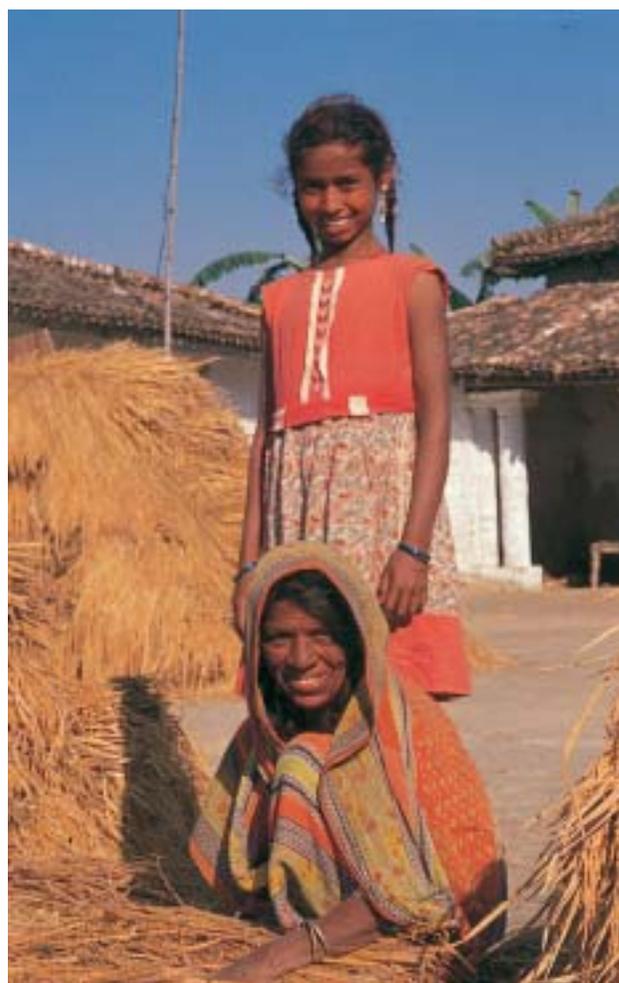
5. *Exploring ways to making water user associations sustainable in the long run.* The newly created water user groups/WUAs are single functional, i.e., irrigation management. In the initial phase of reforms, these organizations may be functional due to financial incentives given to them in the form of grant funds from donors for carrying out necessary activities. However, in the long run, their continued functioning and sustainability and members' participation will depend on the type of incentives the managers and members receive. The likelihood of sustainability of these organizations and their success may be enhanced if they are made *multifunctional with some commercial orientation* (e.g., like emerging farmer companies in Sri Lanka where they carry out irrigation management activities and other income-generating activities), *and using them as vehicles for delivery of services to farmers.* Action research is needed to further understanding the potential *multifunctionality* of water user groups, to explore how these groups in our study countries could be made *multifunctional*, and what would be their implications for the poor.
6. *Strengthening the knowledge base on gender and diversity issues in irrigated agriculture.* On gender and poverty issues, there are indications from our fieldwork that females in low caste/minority households, particularly those in female-headed households, suffer from the worst form of socioeconomic deprivations. The study classifies households in terms of deprivation and poverty of females into the following four categories: a) females in ordinary male-headed households; b) females in ordinary female-headed households; c) females in low-caste/minority male-headed households, and d) females in low-caste/minority female-headed households. The households can be subclassified based on whether or not a household is dependent on agriculture as a main source of income. It is hypothesized that female deprivation and poverty increases in successive categories, with females in the fourth category being the most deprived. More research is needed to better understand poverty among females in both male-headed and female-headed households across ordinary and low-caste/minorities, to devise and target pro-poor interventions that address gender-cum-diversity discrimination issues.
7. *Comparing poverty-reducing impacts of small-scale and large-scale irrigation systems for better targeting irrigation investments.* Our study suggests that the poverty outcomes for canal irrigation systems of varying sizes are mixed. There is no systematic pattern of poverty increasing or decreasing with the size of systems. However, the pattern of higher downstream/tail-end poverty is more pronounced in larger-size systems than in smaller-size systems. The findings from small-scale schemes owned and managed by farmers suggest that development of such schemes can be effective tools for poverty alleviation provided certain preconditions are met (such as access to land and water, access to credit and markets, farm enterprise diversification). The review of the case studies from several countries suggests that while the impacts of irrigation on poverty alleviation across small-scale and large-scale systems may show some quantitative differences, the mechanisms for poverty

alleviation are similar. And there is no conclusive evidence on whether small-scale is better than large-scale for poverty reduction. There is a need for more systematic studies comparing small-scale and large-scale systems in terms of their poverty-reducing impacts in order to develop strategies for better targeting of investments for poverty alleviation.

8. *Understanding dynamics of corruption in irrigation under the changing scenario.* There is no conclusive evidence on whether decentralized management reforms reduce corruption. In the irrigation sector, there is no in-depth cross-country research work on the impacts of irrigation management reforms on corruption. However, there are some indications that

the management reforms have led to a different set of problems and some relate to corruption. It is not clear whether corruption in irrigation has increased or decreased after reforms and whether any changes in corruption are due to reforms or other factors. Two factors can be expected to have led to reduced corruption in irrigation: a) expansion in groundwater irrigation (and conjunctive use of surface water and groundwater) and reduced dependence on canal water as it used to be in the past; and b) improvements over time in information on legal systems. However, more research is needed on understanding the dynamics of corruption in the irrigation sector.

If the misery of the poor be caused not by the laws of nature, but by our institutions, great is our sin (Charles Darwin)



6. Summary of Study Achievements

Table 6: Summary of study achievements, outputs, outcomes and impacts.

Item/Indicators	Total
A. Project participation	
a. Research personnel	
Senior professionals	38
Junior professionals	189
Male professionals	170
Female professionals	57
b. Rural (farm and nonfarm) households	6,637
c. Others (see workshop participation)	846
Total participation	7,700
B. Consultation, communication and dissemination	
a. National/Regional workshops	
No. of workshops conducted	14
No. of stakeholders who participated	846
b. Media coverage	
No. of news items in national newspapers	47
No. of project articles in newspapers	8
No. of project-related items of news on the TV	8
No. of project-related news on the Radio	5
C. Project website	1
D. Written outputs/Reports/Publications	
a. Joint written outputs by IWMI and National Partners (journal articles, research papers, working papers, conference papers, workshop proceedings, project reports, project briefs and other outputs).	59
b. Other publications/reports/papers by national partners.	30
c. Special Issues of an International Journal: Water Policy Vol.5, Nu. 5/6, 2003, Irrigation and Drainage (forthcoming)	1
Total written outputs.	80
E. Capacity development	
a. No. of students financially supported	8
b. No. of trainings conducted	19
c. No. of junior professionals trained	134
d. Other training/capacity building (e.g., PostDocs)	5
F. Outcomes and impacts	
a. Review of global literature on irrigation and poverty.	
b. Methodological framework for analyzing irrigation-poverty impacts.	
c. Irrigation-poverty profiles for each of the six participating countries (covering macro, meso and micro levels).	
d. Individual country-project reports providing detailed analyses of issues addressed in the study for each country .	
e. Summary report providing synthesis of issues, lessons, a set of pro-poor interventions, actions and implementation strategies with detailed guidelines.	
f. Shorter versions of country reports/briefs synthesizing country-specific issues, options and proposed actions for each of the six countries.	
g. Shorter version of the summary report synthesizing generic issues, lessons and guidelines.	
h. Other key outputs—published articles in peer-reviewed journals (Water Policy 2003, International Journal of Irrigation and Drainage 2004, Water International Journal 2004), other published papers, IWMI unpublished papers/reports.	
i. Mass-scale awareness-raising on water and poverty issues in the regions at national and international level through 34 presentations.	
j. National and regional workshops organized for the study—12 national-level workshops (2 in each of the participating countries) and 2 regional-level workshops <i>Note:</i> The study findings/outputs have been referred to or quoted by a number of international organizations including Economic and Research Department of the ADB, World Bank, DFID and others.	
k. International Development Enterprise (IDE), an International NGO, the Pakistan Poverty Alleviation Fund (PPAF), the lead apex organization for poverty alleviation in Pakistan, and the Punjab Irrigation Department/Government of Punjab have incorporated/are incorporating some of the lessons and recommendations of the study into their operational strategies.	

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Appendix A.1: Brief summary of contributions of the study

What we knew before this study	What this study contributes to
There is a trade-off between equity/poverty and productivity—conventional thinking.	High level of inequities in resource distribution is bad for both productivity and poverty. Equities in distribution of land and water are good for both productivity improvements and poverty alleviation.
Irrigation generates a variety of benefits (productivity, employment, wages, incomes) but also leads to problems related to health and environment.	The study develops a generic typology of direct and indirect benefits and dis-benefits of irrigation; quantifies and compares estimates of benefits and dis-benefits, identifies and examines reasons for differential benefits of irrigation across various settings. The study points out that in settings with greater incidence of landlessness, the poor depend on indirect benefits of irrigation, and in most settings the indirect benefits could be much larger than the direct benefits.
Irrigation impacts poverty (but with no consensus - extreme views on the role of irrigation).	The study validates this further by quantifying poverty-reducing impacts of irrigation across various settings. The study identifies channels and pathways through which irrigation reduces poverty. Importantly, the study identifies generic conditions under which irrigation can have strong poverty-reducing impacts (i.e., irrigation can be strongly pro-poor, pro-poor, neutral or antipoor). Therefore, irrigation investments cannot always be assumed to be poverty reducing.
Performance of most medium and large-scale irrigated agricultural systems is unsatisfactory, largely due to inadequate funding and low level of charges, ineffective institutions and policies, lack of community participation, and so on, and such a situation leads to a vicious circle of poor performance.	The study examines a range of factors influencing irrigation performance, and looks into irrigation performance and poverty linkages. Importantly, the study develops a tri-level framework for understanding and addressing irrigation performance issues with a sequence approach. Further, the study develops key indicators for measuring poverty performance of irrigation systems. The study suggests that there are significant opportunities for increasing benefits of irrigation to the poor with the proposed interventions.
Ongoing institutional reforms in irrigation will help solve the problems facing the sector with benefits to the poor.	While the ongoing irrigation reforms being promoted in the study countries, particularly in South Asia, such as IMT and PIM have generated some benefits including for the poor, they are not sufficient in improving system performance and benefits to the poor in a significant way. Further, the study identifies a generic set of conditions under which reform can benefit the poor. The study suggests that unless reforms are sharpened with a pro-poor focus (with effective pro-poor interventions as proposed in the study), the poor are likely to be bypassed as in the past.
Low level of irrigation charges can be justified on grounds of prevailing higher poverty in most countries, especially in South Asia; single level of irrigation service charge applied uniformly across areas and systems is fair and easy to implement.	In settings with greater inequities in land and water distribution, as in India, Pakistan and Bangladesh, low level of irrigation charge does not necessarily benefit the poor, and it could be disadvantageous to the poor where low charges lead to under-spending on O&M works and the system performance suffers. Further, application of a single level of irrigation service charge across areas and systems could lead to situations where the poor end up subsidizing the nonpoor. The study suggests that the irrigation service charging can be designed to meet the dual objectives of improved cost recovery and enhanced benefits to the poor with greater financial autonomy and differential charging policy across areas, systems, locations within systems and across various socioeconomic groups.
Poverty targeting in agricultural areas is very difficult.	The study shows that poverty differs significantly across geographical areas, i.e., irrigated areas vs. nonirrigated areas; high productivity irrigation systems vs. marginal or low productivity systems; upstream vs. downstream irrigation systems; good-quality groundwater vs. poor-quality groundwater areas; and areas inhabited by majorities, high-caste communities vs. minorities, low-caste communities. Poverty is generally more and deeper in the latter than that in the former locations and groups. The differences in poverty situation across these locations and groups suggest that poverty alleviation efforts can be prioritized according to its magnitude and intensity.
Integrated approaches to management of resources.	The study identifies specific areas, approaches and interventions to integrating investments, management and impact evaluations.
Gender issues are important in relation to irrigation and should be addressed.	As much as there is gender discrimination, there is also discrimination of minorities and groups along caste and ethnic lines in irrigation.
There is a need for pro-poor interventions in irrigated agriculture.	The study offers a generic framework for designing pro-poor interventions in irrigated agriculture with specific actions.

Appendix A.2: Options and good practices for designing and implementing ISC for improved cost recovery and benefits to the poor

<i>Options</i>	Cost recovery/ revenue reliability	Benefits to the poor	Ease of implementation
A. Irrigation financing			
(1) Centralized irrigation financing arrangements largely with public funds/subsidies.	Low	Low	High
(2) Decentralized irrigation financing with partial dependence on public funds/subsidies.	Moderate	Low	Moderate
(3) Decentralized irrigation financing with no dependence on public funds/subsidies, only targeted subsidies.	High	High	Moderate
B. Irrigation institutions for managing irrigation finance			
(1) Public-sector agencies at primary, secondary and tertiary levels.	Low	Low	High
(2) Autonomous bodies/WUAs/private sector at secondary and tertiary levels, public agencies at primary/higher level in large systems.	High	High	Moderate
C. Structure of irrigation service charge			
(1) Area-based charging			
(i) A flat rate per hectare of irrigated land regardless of farm size, with control on farm total water supplies through defined entitlement per hectare of farm (i.e., water quota as in warabandi in north India and Pakistan Punjab).	Low	Low	Moderate
(ii) A flat rate per hectare of farm land regardless of farm size, with control on farm total water supplies through defined entitlement per hectare of farm (i.e., water quota as in warabandi in north India and Pakistan Punjab).	Moderate	Low	High
(iii) A flat rate per ha applied to land needed for subsistence (i.e., 2 ha in Pakistani Punjab), and differential rate applied beyond subsistence level with a progressive rate structure (similar to increasing block rate charging) regardless of farm size - with control on farm total water supplies through defined entitlement per hectare of farm (i.e., water quota as in warabandi in north India and Pakistan Punjab).	High	High	Moderate
(2) Crop-based charging			
(i) A variable rate per irrigated crop hectare, different charges for different crops grown (i.e., high charges for high water-consuming crops and vice versa) - with control on farm total water supplies through defined entitlement per hectare of farm.	Low	Moderate	Low
(ii) A variable rate per hectare across seasons, different charges for dry and wet seasons, but flat rate per hectare of farm for all crops grown in a season regardless of farm size - with control on farm total water supplies through defined entitlement per hectare of farm.	Moderate	Low	Moderate

(contd.)

Appendix A.2: (contd.)

Options	Cost recovery/ revenue reliability	Benefits to the poor	Ease of implementation
(iii) A variable rate per hectare across seasons, different charges for dry and wet seasons, but flat rate per hectare of farm for all crops grown in a season regardless of farm size. A flat rate per ha applied to land needed for subsistence (i.e., 2 ha in Pakistani Punjab), and differential rate applied beyond subsistence level with a progressive rate structure (similar to increasing block rate charging) regardless of farm size - with control on farm total water supplies through defined entitlement per hectare of farm.	High	High	Moderate
(3) Volumetric-based charging: a flat or variable rate per unit of water delivered to farms (not feasible due to lack of water-measuring devices at the farm level).	Moderate	Moderate	Low
(4) Multilevel, multipart charging			
(i) At primary and secondary levels where water can be usually measured, volumetric charge applied with two components – basic charge component - flat rate per ha of command area irrigated and a— variable charge component - a flat or variable rate per unit of water delivered.	High	High	
(ii) At the tertiary level (i.e., WUA level) where water measurement is usually difficult, charge applied as 1-iii (are based charging) or 2-iii crop based charging (as suggested above).			Moderate
D. Level of irrigation service charge			
(1) Low level of ISC based on historical trends.	Low	Low	High
(2) ISC linked to service delivery and O&M costs.	Moderate	Moderate	Moderate
(3) ISC linked to service delivery, O&M costs and benefits of irrigation.	High	Moderate	Moderate
E. Uniform or differential charging (in settings with high inequity in land and water distribution)			
(1) Uniform rate for all systems, locations, regardless of the level of service, O&M costs, and socioeconomic status of irrigators.	Low	Low	High
(2) Different rates for each system, locations within systems (head-tail), level of service, O&M costs, and socioeconomic status of irrigators.	High	High	Moderate
F. Service delivery and ISC contracts			
(1) No formal irrigation service delivery and ISC contracts.	Low	Low	High
(2) Formal irrigation service delivery and ISC contracts.	High	High	Moderate
G. Arrangements for ISC assessments, collection and spending			
(1) Public-sector agencies.	Low	Low	High
(2) WUAs/FWUAs.	Moderate	High	Moderate
(3) Private sector/third party.	High	Moderate	Moderate

(contd.)

Appendix A.2: (contd.)

<i>Options</i>	Cost recovery/ revenue reliability	Benefits to the poor	Ease of implementation
H. Irrigation service charge collection/payment			
(1) Payments after harvest.	Low	High	High
(2) Partial payment in advance.	Moderate	Moderate	Moderate
(3) Full payments in advance.	High	Moderate	Moderate
I. Mode of payment			
(1) Payment in kind.	Moderate	Moderate	Low
(2) Payment in cash.	High	Moderate	High
J. Incentives to farmers for ISC payments			
(1) Financial incentives for advance payments.	High	Moderate	High
(2) Suspension of water deliveries.	Moderate	Low	Low
(3) Legal action.	Low	Low	Low
K. Incentives for ISC system implementation			
(1) Financial incentives for ISC assessment and collection performance (incentives varying with performance).	Moderate	Moderate	Moderate
(2) Financial incentives for efficiently implementing entire financing systems including ISF assessment, collection, record keeping, spending, etc.) – with appropriate regulation, transparency and accountability mechanisms built in.	High	High	High
L. Incentives to improved performance			
(1) Financial incentives to service providers to meet or exceed the cost-recovery objective.	High	Moderate	Moderate
(2) Financial incentives to service providers to meet or exceed irrigation system-performance standards.	High	Moderate	Moderate
(3) Financial incentives to service providers to meet or exceed objectives to enhancing benefits to the poor (pro-poor management).	High	High	Moderate

Appendix A.3: Indicators for estimating benefits of irrigation to the poor

We propose the following indicators for estimating benefits of investments in new irrigation or in improving performance of irrigation systems to the poor. We hope that donors, policy makers and managers will find them useful in their assessments and decisions on irrigation.

$$\text{Benefits to the poor} = \left[\frac{\text{net benefits to the poor}}{\text{total net benefits}} \right]$$

$$\text{Benefits to the poor} = \left[\frac{\text{no. of the poor benefited}}{\text{total number of the poor}} \right]$$

$$\text{Benefits to the poor} = \left[\frac{\text{share of the poor in total net benefits}}{\text{share of the poor in total population}} \right]$$

$$\text{Benefits to the poor} = \left[\frac{\text{share of bottom 20 percent (income) population in total net benefits}}{\text{share of top 20 percent (income) population in total net benefits}} \right]$$

$$\text{Benefits to the poor} = \left[\frac{\text{Share of the poor women headed households in total net benefits}}{\text{Share of the poor women headed households in total population}} \right]$$

Appendix A4. Salient features of the selected irrigation systems.

Country	System name	Location	Date of construction	Management	Size (ha)	Annual rainfall (mm)	Major crops	Source of water	Water availability	Sample size (number)
Bangladesh	G-K	South-western Bangladesh	1969	Agency-managed	142,000	1,500	Rice, pulses, oilseeds, tobacco	Both SW and GW	Water-short	400
	Pabna	West-central Bangladesh	1992	Agency-managed	145,300	1,900	rice, pulses, vegetables	Both SW and GW	Water-adequate	400
India	NSLC	Andhra Pradesh/Krishnia River- Upstream	1955	Transferred	246,000	750	Rice-groundnut	Mainly SW	Water-short	300
	KDS	Andhra Pradesh/ Krishnia River- Downstream	1852	Transferred	508,000	900	Rice, pulses, vegetables	Mainly SW	Water- Adequate	240
	Halali	Madhya Pradesh	1973	Transferred	23,500	1,050	Wheat, soybean, pulses	SW	Water-short	217
	Harsi	Madhya Pradesh	1925	Transferred	41,500	850	Wheat, rice, gram	Both SW and GW	Water-short	205
Pakistan	9-R	Upper Jehlum canal	1915	Agency-managed	5,950	644	Rice-wheat	Both SW and GW	Water-short	90
	10-R	Upper Jehlum canal	1915	Agency-managed	4,370	644	Rice-wheat	Both SW and GW	Water-short	90
	13-R	Upper Jehlum canal	1915	Agency-managed	2,870	644	Rice-wheat	Both SW and GW	Water-short	90
	14-R	Upper Jehlum canal	1915	Agency-managed	22,180	644	Rice-wheat	Both SW and GW	Water-short	90
	Kakowal	Upper Jehlum canal	1915	Agency-managed	9,270	644	Mixed-wheat	Both SW and GW	Water—short	90
	Phalia	Upper Jehlum canal	1915	Agency-managed	26,910	644	Mixed-wheat	Both SW and GW	Water—short	90
	Lalian	Lower Jehlum canal	1901	Agency-managed	44,480	413	Mixed-wheat	Both SW and GW	Water-short	171
	Khadir	Lower Jehlum canal	1901	Agency-managed	47,430	413	Mixed-wheat	Both SW and GW	Water-short	171
	Khikhi	Lower Chenab canal	1892	Agency-managed	32,940	372	Mixed-wheat	Both SW and GW	Water-short	171
	Hakra-4	Hakra System	1937	Transferred	17,850	196	Cotton-wheat	Both SW and GW	Water-short	171
China	WID-NP	Ningxia Province-North western China (upper YRB)	B.C	Village cooperatives	56,000	200	Wheat-rice-maize-other	SW	Water-short	34
	QID-NP	Ningxia Province-North western China (upper YRB)	B.C	Village cooperatives	304,000	195	Wheat-rice-maize-other	SW	Water-short	95
	PID-HP	Henan Province- Eastern China (Lower YRB)	1952	Village cooperatives	99,000	620	Wheat-rice-maize-other	Both SW and GW	Water-short	66
	LID-HP	Henan Province- Eastern China (Lower YRB)	1967	Village cooperatives	31,000	639	Wheat-rice-maize-other	Both SW and GW	Water-short	36
Vietnam	Nam Duang	Red river delta	1962	Village cooperatives, IDMCs	16,775	1,700	Rice and upland crops	Mainly SW	Water-short	480
	Nam Thach Han	North Central Region	1978	Village cooperatives, IDMCs	7,657	2,609	Rice	Mainly SW	Water- adequate	480
Indonesia	Klambu Kiri	Central Java	1987	Agency-managed	21,475	2,092	Rice, mungbean, soybean	SW	Water-short	300
	Glapan	Central Java	1930	Agency-managed	18,284	2,458	Rice, mungbean	Mainly SW	Water-short	250
	Kalibawang	Yogyakarta	1940	Transferred	6,454	2,291	Rice, vegetables	Mainly SW	Water-adequate	250
	Krogowanan	Central Java	1976	Transferred	813	2,065	Rice, soybean, maize, vegetables	SW	Water-abundant	101

Notes:

IDMCs = Irrigation and Drainage Management Companies.

G-K = Ganges Kobadak; NSLC = Nagarjuna Sagar Left Bank canal; KDS = Krishna Delta Systems; WID-NP = Weining Irrigation District in Ningxia Province; QID-NP = Qingtongxia irrigation district in Ningxia Province; PID-HP = People's Victory Irrigation District in Henan Province; LID-HP = Liuyuan kou Irrigation District in Henan Province. SW = surface water; GW = groundwater.

Appendix A5. Proposed country-specific interventions and actions

The table below provides the identified country-specific interventions and actions. These are based on detailed examination and analyses of issues in the country reports, discussions and presentations made during the country workshops, inputs from stakeholders including country policy-makers, irrigation managers, ADB country representatives, NGOs, researchers and other stakeholders. For more details, readers may refer to detailed country-specific reports or country-specific synthesis briefs.

Country	Proposed interventions and actions
Bangladesh	<ul style="list-style-type: none"> • <i>Increase the Area Irrigated</i>—Further investment is needed to ensure that the whole potential command area of systems is irrigated. Targeting new investments at poor communities is a priority. • <i>Involve Beneficiaries in Irrigation Management</i>—Public-sector agencies alone have not significantly improved agricultural performance. PIM or irrigation management transfer (IMT) activities should be used to ensure WMGs and WMAs are formed, function effectively, and participate fully in O&M. The BWDB should also operate more transparently. Regular consultation with farmers and the WMGs and WMAs representing them should be mandatory. • <i>Distribute Water Equitably within Each System</i>—Action is needed to ensure that water is available equally across all reaches of the system (head, middle and tail), as well as to all socioeconomic groups (e.g., small and marginal farmers). The three-tier reform model should be implemented effectively, as it emphasizes participatory approaches and represents the poor and those at the disadvantaged locations. • <i>Reduce Water Losses</i>—Surface water is becoming increasingly scarce. Water losses from canals need to be cut through proper maintenance, user involvement, and canal lining in selected areas, through further targeted investments. • <i>Promote Crop and Enterprise Diversification</i>—Farmers should be helped to move away from monocropping rice towards growing high-value crops. They should be helped to start farm enterprises appropriate to their agronomic and agro-ecological settings. Efforts should be linked to the new National Water Policy, the new National Water Management Plan and the new Agricultural Policy. • <i>Build Effective Partnerships</i>—To improve agricultural yields per unit of labor, irrigation water and land, integrated application of irrigation, seed and fertilizer technologies are needed. This should be achieved by building effective partnerships between BWDB and other government agencies on the one hand and WMGs/WMAs on the other. • <i>Adopt an Integrated Approach to Service Delivery</i>—An integrated approach should be adopted to reduce poverty and increase production. This would view irrigation as one critical production input, combining it with the provision of credit, agricultural inputs, marketing services and information in an integrated framework. • <i>Implement the Three-Tier Reform Structure Comprehensively</i>—The existing WMGs and WMAs are not yet fully active in all areas, even in the long-standing G-K project. In different parts of Pabna, they are still in the early stages of operation or formation. Steps need to be taken to make these organizations more effective. So, the management of all canals at the tertiary level and below should be handed over to WMGs, avoiding piecemeal implementation of the reform. • <i>Establish Equitable Irrigation Rights and Obligations</i>—No regulations exist for dealing with nonpayment of irrigation charges. Also, the National Water Policy does not specifically address irrigation rights and obligations. These should be established at both policy and operational levels, and WMGs and WMAs should ensure they are properly observed in the field—to ensure equity in water distribution and efficiency in water use. • <i>Improve Irrigation-Charge Collection</i>—Throughout Bangladesh, irrigation-charge collection rates are poor. Because the sums collected do not cover even a small part of the cost of O&M, less is spent on system maintenance than is required. So, assessment and collection of irrigation charges, and revenue-spending responsibilities should be handed over to the wateruser organizations.

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Country	Proposed interventions and actions
	<ul style="list-style-type: none"> • <i>Increase Employment Opportunities for Marginal Farmers and the Landless</i>—IMT agreements should include provisions for giving maintenance and water-distribution work to the land-poor and landless, along the lines of LCS, CMG and EMG groups. This should be one of the important pro-poor dimensions of irrigation reforms. • <i>Promote Off-Farm Rural Activities for the Land-Poor and Landless</i>—As agricultural incomes increase, because of improved irrigation management and agricultural practices, the scope for new agro-support activities (e.g., supply of fertilizer, pesticide, farm implements, etc.) and agro-processing opportunities (e.g., vegetable and fruit processing) will expand. The land-poor and landless could start up small enterprises in these areas, if they are given appropriate advice, and if credit, technologies and other needed services are made available. • <i>Redistribute Land</i> —<i>In the long term, greater emphasis should be placed on creating permanent assets for the poor</i>, by redistributing land to the marginal farmers and the landless through effective (administrative, or incentive- and market-based) land reforms. This would help alleviate poverty, by increasing productivity and improving the equitable distribution of the benefits brought by new investments in the irrigation sector.
India	<ul style="list-style-type: none"> • <i>Improve Head–Tail Equity in Water Distribution</i>—The tail reaches of irrigation systems suffer low productivity and high poverty rates. This is partly because farmers in the upper reaches use more than their allocation of water, to illegally irrigate land not originally included in the system. Inadequate planning and design have contributed to this problem—because of pressure to meet targets and include large areas within the project. What’s more, poorly maintained canals cannot deliver enough water to the tail ends. Excess water withdrawals by head-end farmers therefore urgently need to be addressed, and canal maintenance and design improved. • <i>Encourage Crop Diversification</i>—Farmers prefer to grow rice, which consumes a lot of water. This, and a lack of water regulations, means that head-end farmers use more water than they should—leaving less for the water-scarce reaches lower in the system and contributing to the low yields obtained there. Encouraging farmers to diversify and grow less rice could address this. But, this requires sustained efforts at all levels of management and policy. • <i>Improve Institutional Arrangements</i>—Water is distributed most equitably in the older irrigation systems studied (KDS and Harsi). Plus, wages there are higher, as are the outputs per hectare obtained by tail-end farmers. Consequently, poverty levels are lower. Caste issues are also not so strongly apparent. These benefits result from the fact that the institutions in these systems are better developed and function more efficiently. They have also quickly adapted to reform, embracing farmer management and WUA formation, for example. Efforts should therefore be made to develop the management institutions in place in India’s other irrigation systems—to benefit users directly and speed the reform process. • <i>Improve Rate-Setting and Fee-Collection Mechanisms</i>—Despite reforms intended to increase farmers’ involvement in irrigation systems, water charges are still fixed and collected by the government. Even in AP, where provision has been made to revise water rates periodically, procedures have not been clearly defined. Equitable rate setting could have significant pro-poor benefits. Clearly defining procedures would help address this. Fee-collection mechanisms also need to be improved, as collection rates are very poor. The fact that funds, when collected, are being misappropriated also urgently requires action. To encourage users to pay, the service delivered needs to be improved and the charges applied made more transparent. Key problems include a lack of clear-cut water-delivery schedules, the fact that the volumes of water used are not measured, and the fact that water allocation plans are not drawn up before each agricultural season. • <i>Build the Management Capacity of System Officials</i>—Irrigation officials and farmers need to be trained, to help them address and implement the various aspects of irrigation-sector reforms. These groups also need to be taught to work together efficiently. However, mechanisms for this are lacking. Appropriate policy support should therefore be provided, to help build capacity and improve the operation of institutions, and ensure devolution of power from irrigation departments to WUAs, DCs and establishing effective project committees.

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Country	Proposed interventions and actions
	<ul style="list-style-type: none"> • <i>Combat Land Degradation</i>—Land degradation is an increasing problem in irrigated areas, as salt levels are increasing and waterlogging is becoming more common. Signs of waterlogging, for example, are now apparent in the head ends of both KDS and Harsi. This issue needs to be addressed, both by revising policy and by direct action by WUAs. • <i>Increase the Number of Women Managers in WUAs</i>—Steps need to be taken to increase women’s participation in WUA management. A few women have made a substantial contribution to the functioning of WUAs in MP and AP. But, most simply act as proxies for their husbands, or are “present” only to secure aid from the government. • <i>Implement Legal Reforms to Protect Vulnerable Groups</i>—IMT’s institutional changes have had positive impacts. However, many of the issues facing the poor and the landless are not dealt with by India’s PIM Acts. Legal provision needs to be made, especially with regard to water rights, to protect these vulnerable groups and allow them to benefit from reform.
Pakistan	<ul style="list-style-type: none"> • <i>Create Assets for Poor Men and Women</i>—Pro-poor governance should be encouraged and safety nets and physical, social and economic assets created for the poor. Redistribution of land to landless rural households is a key first step. Currently, 0.29 million hectares of land taken from large landowners during land reforms, and 0.89 million hectares of largely undeveloped state land are available. The government should also introduce incentive- and market-based land reforms—even if this means buying land for distribution to the landless poor (who constitute the bulk of the rural poor) and to poor and marginal male and female farmers. All holdings should be large enough to support a family. The effective creation of land assets for the poor would improve the distribution of benefits from water-sector investments and significantly reduce rural poverty. • <i>Improve Performance of, and Service Delivery in, Irrigation Systems</i>—The performance of Pakistan’s irrigation systems could be improved significantly, greatly reducing poverty. Institutional reforms such as the Hakra-4R IMT model—which benefits the poor by improving water distribution and crop productivity—should be replicated in other canal commands. However, strong regulatory backup and monitoring is needed, to ensure that the poor receive the expected benefits, and that poor small-scale farmers and those at the tail ends are represented in WUAs and FOs. Although management organizations should operate as commercial utility companies, they should also meet performance-improvement and pro-poor targets. System handovers should be accompanied by improvements in irrigation infrastructure and higher irrigation-service charges. • <i>Make Irrigation Systems Financially Self-Sufficient</i>—Systems should be financed through the full recovery of O&M costs. The present charging policy harms the poor, so the level and structure of charges should be corrected, with charges being related to service delivery. The proposed differential-rate strategy could be adopted to benefit the poorest. • <i>Integrate Management of Surface Water and Groundwater</i>—Access to canal water and groundwater quality both vary greatly among canal commands. Poor farmers often rely more on groundwater than larger farmers do. Since the study found that conjunctive management of surface water and groundwater boosts productivity and is pro-poor, the two resources need to be managed jointly, especially in poor areas. • <i>Improve the Access of the Poor to Inputs and Services for Increasing Agricultural Productivity</i>—As crop productivity (per unit of water and land) is low, better access to production inputs (water, fertilizer, improved crop varieties, etc.), and better marketing of outputs are needed. One solution may be the integrated, low-cost delivery of the major inputs and services. This could be achieved by involving the private sector (with the public sector playing an important role as an enabler, facilitator and regulator). However, more research is needed on this intervention. • <i>Enhance Benefits of Irrigation to the Poor</i>—Crop diversification and the use of resource-conserving technologies were found to have significant impacts on farm incomes and poverty. So, the benefits of available irrigation water resources could be enhanced by diversifying into high-value crops (including nonconventional crops). The effective dissemination of existing resource-conserving technologies and the development of new technologies also offer ways forward.

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Country	Proposed interventions and actions
China	<ul style="list-style-type: none"> • <i>Target New Investments to the Poor</i>—In many areas, investments are needed to further develop, improve and rehabilitate surface-water supply systems. New investment should target poor men and women, both geographically and socioeconomically. • <i>Target Irrigation Investment at Poorer Areas—Because irrigation improves crop yields, crop revenues and farm incomes—and because farmers in poor areas rely more on crop revenues—more investment in poor areas will boost the incomes of the poor relatively more than those of richer farmers.</i> • <i>Reallocate Water within River Basins to Address Water Shortages</i>—In areas that receive less irrigation water per hectare, productivity is not necessarily lower, and poverty rates are not necessarily higher. For example, water is used more productively in the Yellow river’s lower reaches, where IDs are allocated less water than those in the upper reaches. So, water allocation could be evened out by reducing supplies to upper reaches, to boost overall water-use efficiency. • <i>Rehabilitate Infrastructure Regularly</i>—To improve the reliability of water supplies, more has been invested in the lower reaches than in the upper—resulting in higher productivity and returns to farming. Irrigation investments have been shown to increase farm incomes and reduce poverty. So periodic, government-funded rehabilitation should continue, to encourage users to invest in maintenance. • <i>Increase Water Charges and Improve Fee-Collection Rates</i>—China’s agricultural water is still believed to be under-priced. Water charges need to be increased, to cover the full cost of O&M. Plus, because nearly 20 percent of water fees are not collected, collection rates should be improved. Private contractors/managers have more success collecting fees—sometimes by adopting strict measures—so this is a point in favor of moving away from collective management. • <i>Continue Reforms that Favor Contracting and the Creation of WUAs</i>—Where water-management reforms are being implemented (by creating WUAs or using private contractors/managers) irrigation systems generally perform better than those under collective management. So, reforms are working, and should be continued.<i>Improve Implementation of Reforms that Involve Water-Saving Incentives</i> - Water-management reforms that provide strong financial incentives for managers to increase water-use efficiency will reduce overall water use with no adverse impacts on farm incomes and poverty. So, the government should continue to support institutional reforms in irrigation management, implementing them more widely and effectively.<i>Train Water Managers</i> - The capacity of water managers should be developed through training programs, to help them implement water-sector reforms effectively.<i>Lessons for Other Developing Countries</i> - China’s small- and large-scale farmers have almost equal access to water. Indeed, water is sometimes allocated to favor the poor. Such overall equity results not only from the use of water-related institutions and water policies. A combination of other policies facilitates the equal distribution of land and rapid expansion of off-farm employment, while ensuring that irrigation water is allocated and distributed based on farms’ cultivated land area.
Indonesia	<ul style="list-style-type: none"> • <i>Redesign Irrigation Systems and Encourage Agricultural Diversification</i>—Crop diversification improves the incomes of poor farmers, helping to alleviate poverty. But, the irrigations systems in place are not designed to support this. So, redesigning these systems would help alleviate poverty. At the same time, appropriate approaches and technologies should be promoted to encourage agricultural diversification and realize the pro-poor impacts of irrigation. • <i>Improve Ministerial Commitment to Irrigation Reform</i>—Indonesia’s irrigation reforms lay the foundations for improvements in people’s standards of living. But, changes need to be made to ensure that irrigation-sector reforms proceed smoothly. There have been political differences and clashes among higher authorities over the transfer of irrigation management to farmers and district-level irrigation financing. So interdepartmental coordination and political commitment at the national level need to be improved. • <i>Train Government Officials</i>—Capacity building is needed for government officials, to help them address and implement newly introduced irrigation laws and policies. Local government officials should also be helped to understand, interpret, and implement the new policies effectively. • <i>Train WUA Members</i>—Farmers and WUAs lack the capacity and knowledge needed to manage the secondary and primary levels of systems. So, they need training, and a number of management tools:

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Country	Proposed Interventions and actions
	<ul style="list-style-type: none"> • <i>O&M Manual</i>—Before IMT was implemented, WUAs were supposed to follow national O&M directives from central government (which were not always carried out). Now, after IMT, each system should have its own O&M manual, developed with the full participation of WUA members, to provide specific guidelines for running and maintaining that system. • <i>Asset Management Plan</i>—Because the condition of irrigation-system infrastructure affects water deliveries, an asset management plan should be developed to improve the maintenance of canal infrastructure, gates, etc. <i>Information system</i>—Data and the information base related to water resource management remains weak. Data on water resources, water flows, water distribution, cropping patterns, crop yields, infrastructure and assets should therefore be recorded, to allow regular monitoring of system performance and O&M planning by WUAs and government agencies. • <i>Build Partnerships and Strengthen Inter-Sectoral Linkages</i>—Local partnerships need to be promoted to support pro-poor irrigation and agribusiness development. Partners should include the state, the private sector, and civil-society organizations such as universities, and nongovernmental and community-based organizations. Local-level inter-sectoral linkages also need to be strengthened, to raise productivity and increase the poverty alleviating benefits of irrigation investment. Links should be created among village unit cooperatives (KUDs), extension workers, rural banking institutions, markets and produce-storage systems.
Vietnam	<ul style="list-style-type: none"> • <i>Improve Coordination and Communication</i>—As many institutions are involved in irrigation management, effective coordination and good communication are vital—particularly between IDMCs and cooperatives. Communication and coordination should also be improved within the IDMCs—between the Board of Directors, technical/water management and financial/administration departments and the field stations. • <i>Improve the Administrative and Incentive Environment</i>—Clearly written water delivery schedules and requests from the IDMC head office, field stations, and cooperatives are needed. <i>Up-to-date information</i> on water availability and deliveries should also be received by the head office. Strict <i>monitoring and enforcement</i> of field stations and cooperatives on water delivery in secondary and tertiary canals are essential. The administrative environment should ensure <i>rapid and timely action</i> during droughts. And, irrigation managers should be given <i>better incentives</i> to improve water management. • <i>Reform Cooperatives</i>—There are ongoing efforts to reformulate cooperatives—to make them village-based rather than commune-based. Although commune-level cooperatives still exist in some areas, their role is very formal. The actual body responsible for agricultural activities—especially water management—is the village. <i>The traditional village community is the most effective terminal unit in the multilayer organizational structure of irrigation management.</i> The constraint is lack of detailed research on terminal units and pilot models to test the findings. • <i>Develop Water-Control Structures</i>—In the Central Coast region major causes of poverty are droughts and floods. But, the damage they cause has been drastically reduced in Nam Thach Han, through the development of a major water-control infrastructure. This helped to prevent 13 percent of farmers falling below the poverty line during the 2002 drought. Such structures could improve conditions in similar areas, improving farmers' welfare and preventing the non-poor from re-entering poverty. • <i>Improve Drainage Management</i>—Improving the management of drainage courses—and increasing their capacity allow better draining of flood water and storage of irrigation water. In Nam Thach Han, for example, a large proportion of the system's water is wastefully released into the Vinh Dinh river and the sea. Using this drainage course more productively would allow more of the command area to be irrigated. • <i>Increase Investment in Irrigation</i>—Providing irrigation to rain-fed areas, and improving irrigation and drainage in irrigated areas, could greatly reduce poverty. Farmer incomes and land-use intensity could be increased. Rice producers could also diversify and grow high-value vegetables. This would, however, require significant investment.

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Country	Proposed interventions and actions
	<ul style="list-style-type: none"> • <i>Strengthen the Legal and Policy Environment</i>—Clear and consistent laws and regulations are needed to deal with water fees and punish individuals stealing water. To implement and enforce these regulations, responsible parties at different levels should be identified and granted the necessary authority. Means should also be found to fund and support such efforts, and users and managers should be educated about the regulations. Strong, flexible and dynamic policies are needed—to suit the conditions prevailing at different times and in different areas. • <i>Involve Farmers More in Irrigation Management</i>—There is an urgent need to integrate male and female farmers strongly into the management process (especially the setting of water-delivery schedules). This would make management more transparent, and more responsive and accountable to water users. Pilot studies would be valuable in identifying the most effective way of achieving this. • <i>Develop Financially Self-Sufficient Irrigation Institutions</i>—Water fees are key to establishing self-financing institutions. Currently fees are low. But, this means that few funds are available to pay managers or to construct, maintain or repair irrigation infrastructure. A sound financial cycle should be developed, which takes into account potential impacts on the poor, local needs and conditions, and constraints faced by the central government. • <i>Ensure Research is Action- and Policy-Oriented</i>—Research should target topics relevant to policymakers' concerns and yield practical answers to their questions. Better cooperation between researchers and policymakers would help them to coordinate their efforts, bring together disparate agencies and institutions, and refine the national research agenda.

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